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Measuring Officer Knowledge and Experience to Enable Tailored Training

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14. ABSTRACT *(Maximum 200 words)*:

Tailoring training can improve effectiveness and efficiency. However, before informed decisions regarding tailoring Army institutional training can be made, instruments that predict performance must be available. To that end, instructors from the Engineer Captain's Career Course at Fort Leonard Wood, MO were interviewed to determine which course criterion exhibited large variation in officer performance. Based on those interviews, the criterion of defensive planning was chosen. Five types of predictors were constructed. The first type was predictive judgments of criterion performance. The second type was biodata items. The third and fourth types consisted of self-report items measuring training experiences in criterion-relevant activities and confidence in one's own ability to carry out criterion-relevant actions. The fifth type was a test of prior knowledge. Results showed that prior knowledge alone predicted criterion performance, but only for officers with no prior enlistment experience. In addition, the interrelationships among the variables differed markedly between officers with prior enlisted experience and officers without. These results underscore the need for empirically validating performance predictors in Army courses. We discussed in detail how these findings enable instructors to make informed decisions about tailoring training.

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prior knowledge, tailoring training, performance prediction, defensive planning, Engineer Captain's Career Course, subgroups

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MEASURING OFFICER KNOWLEDGE AND EXPERIENCE TO ENABLE TAILORED TRAINING

EXECUTIVE SUMMARY

Research Requirement:

The U.S. Army requires effective and efficient training. However, what is effective and efficient varies from group to group and individual to individual. For decades researchers have explored the extent to which training efficiency/effectiveness can be improved by tailoring training, that is, by assessing salient individual differences and assigning learners to learning conditions based on those differences. Criterion-relevant experience and prior knowledge are arguably the most robust predictors of performance, and therefore are viable bases for tailoring training. On this basis, effective and efficient measures of experience and prior knowledge should be developed and empirically validated. Such valid measures are required if instructors are to adapt training to individuals who vary in prior knowledge and experience.

Procedure:

Instructors from the Engineer Captains Career Course (ECCC) at Fort Leonard Wood, MO, were interviewed to determine which parts of the course could best distinguish the performance of different officers. Based on those interviews, performance on the Defensive Planning exam was chosen, as it clearly indicated some officers as performing well, some average, and some poorly. Five types of predictors were constructed to assess how they were related to how well officers performed on the Defensive Planning exam. The first was small group instructors' (SGI) forecasts of officers' later performance on their Defensive Planning exams. The second was general biographic characteristics of the officers, which anecdotal evidence indicated instructors used to assess relevant experience. The third was officers' scores on a measure that asked questions relevant to their Defensive Planning training and educational experiences. The fourth asked officers to rate their own ability to execute activities related to Defensive Planning. The fifth type was a test of prior knowledge. The instruments were reviewed and approved by the instructors, and the final version was administered to 5 SGIs and 78 students.

Findings:

Analyses revealed a complex relationship between officers' prior enlistment experience and prior knowledge, and their performance on the Defensive Planning exam. For officers with prior enlistment experience, there were no significant predictors of exam performance. For officers without prior enlistment experience, prior knowledge alone was a significant predictor. Analyses also showed that for officers without prior enlistment experience, the predictors and criterion were systematically related in a way strikingly similar to that seen in the occupational research literature. This similarity did not hold for the prior-enlisted officers, however. We discussed in detail how these findings provide information which could be used to enable course personnel to make informed decisions about tailoring training.

Utilization and Dissemination of Findings:

The findings demonstrate the utility of prior knowledge measures for predicting performance and thus informing subsequent implementation of tailored training. These findings have been disseminated to Engineer Captains Career Course instructors at Fort Leonard Wood, MO and briefed to U.S. Army Training and Doctrine Command (TRADOC) personnel at Fort Eustis, VA.

MEASURING OFFICER KNOWLEDGE AND EXPERIENCE TO ENABLE TAILORED TRAINING

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MEASURING OFFICER KNOWLEDGE AND EXPERIENCE TO ENABLE TAILORED TRAINING

Introduction

Operational tempo requires U.S. Army personnel to learn more in less time, and thereby highlights the need for effective and efficient training. Given that fact, we also know that there is great diversity in the Army in terms of individual learning differences related to learning ability, learning preferences, prior knowledge, prior experiences, etc. There is ample evidence to suggest that learning-related individual differences exist (Jensen, 1998; Thorndike, 1985) and that these individual differences interact with learning conditions (McNamara, Kintsch, Songer, & Kintsch, 1996). That is, a given approach to training may be effective and efficient for one type of learner but not another.

This suggests the need for tailored training. The central idea to tailored training is that it is possible to assess salient individual differences and then assign learners to learning conditions based on those differences. For example, individuals high in prior domain knowledge do better when textbooks reserve explanations for more advanced concepts. Conversely, individuals low in prior domain knowledge do better when explanations are given for easy concepts as well (McNamara, Kintsch, Songer, & Kintsch, 1996).

For such tailored training to be effective, at least two conditions must be satisfied. First, there must be evidence demonstrating a significant relationship between one or more individual differences and performance. Second, there must be evidence of an interaction between one or more individual differences and the training condition (Pashler, McDaniel, Doug, & Bjorn, 2009). Returning to the textbook example of McNamara et al., the first condition is met by the existence of a significant relationship between a prior knowledge test and a test on the textbook content. The second condition is met by the fact that prior knowledge interacts with type of textbook. Namely, high prior knowledge individuals perform better with the textbook which explains only advanced concepts, while low prior knowledge individuals perform better with the textbook which explains the simple concepts as well.

The goal of this research was to satisfy the first condition—to develop and empirically validate one or more individual difference measures that are significantly related to criterion performance in an officer course. After we assessed the evidence for such a relationship, we explored how the predictor information might be used to assign individuals to different training conditions.

We chose to focus primarily on the individual difference of prior knowledge (defined as information, facts, and procedures required for successful performance in a domain—see Palumbo, Miller, Shalin, & Steel-Johnson, 2005). There are at least four reasons for doing this. First, previous research was not successful when it sought to select predictors on the basis of having instructors identify individual differences they perceived to be relevant to performance (Schaefer, Bencaz, Bush, & Price, 2010). This suggested a new approach was needed. Second, measuring prior knowledge is often an efficient means of predicting performance. This is likely because measuring prior knowledge captures the joint effects of domain experience and general

mental ability (Borman, White, Pulakos, & Oppler, 1991; Borman, White, & Dorsey, 1995; Palumbo, Miller, Shalin, & Steel-Johnson, 2005; Schmidt & Hunter, 1993; Schmidt, Hunter, & Outerbridge, 1986). Evidence indicates that general mental ability is the most robustly predictive of broad psychological constructs (Goska & Ackerman, 1996; Gottfredson, 1998; Jensen, 1998; Thorndike, 1985). However, general mental ability would seem to affect performance through the acquisition of prior knowledge. In addition, experience (often measured simply as self-reported length of time working in a given domain) also affects performance through the acquisition of prior knowledge. In other words, general mental ability plus experience within a domain contributes to prior knowledge, which in turn contributes to criterion performance. This means that general mental ability and experience significantly predict prior knowledge, but not criterion performance. Prior knowledge, as the variable most directly related to criterion performance, does significantly predict criterion performance. Third, the most replicated tailored training effects involve general mental ability and prior knowledge (Kalyuga, Ayres, Chandler, & Sweller, 2003; Snow, 1991, 1992). Fourth, we know that military personnel sometimes vary in amount of prior knowledge (e.g., with digital systems; see Bink, Wampler, Goodwin, & Dyer, 2008).

However, given the possibility that other, more easily acquired measures (e.g., biodata data and experience) may also be correlated with criterion performance, we did not rely solely on prior knowledge measures. Instead, we also constructed four other types of predictors. First, we asked small-group instructors (SGIs) in the Engineer Captains Career Course (ECCC) to predict the criterion performance of the officers. Second, we had the officers complete a biodata questionnaire containing general information items (e.g., military occupational specialty or MOS [the officers' career field], deployment experience, etc.). Third, we constructed experience scales that assessed various aspects of specific, criterion-related activities. Fourth, we asked officers to rate their own ability (i.e., express confidence in their ability) to carry out criterion-related activities.

Our rationale behind the choice of these predictor types was as follows. First, it is of obvious interest to see how accurately SGIs can predict officer performance, as presumably adjustments to instruction when made are often based on such judgments. Further, research indicates that job supervisors appear to base their assessments of supervisee job performance more on prior knowledge than actual job performance (Schmidt et al., 1986). In other words, supervisor perceptions of supervisee performance are more correlated with job knowledge than with actual job performance. Including instructor predictive judgments allows us to see if a similar pattern held for SGI predictions of officer criterion performance. Second, anecdotal evidence indicates that many instructors rely on informal cues like rank and deployment experience to make predictions about officer performance. Formally assessing the predictive power of such cues via the biodata questionnaire allowed us to estimate the practical utility of such information. Third, constructing experience scales related to specific, criterion-related activities might be expected to yield more robust prediction than less targeted predictors like deployment. Further, the biodata and experience scales were intended to address a difference between the occupational literature and Army institutional settings. In the occupational literature, experience is measured by simply asking individuals how long (e.g., months) they have been engaged in a specific domain (Schmidt & Hunter, 1993; Schmidt et al., 1986). Given the different duty assignments performed by U.S. military personnel, analogues of such simple

measures (e.g., time-in-grade or time-in-service) were judged unlikely to significantly predict criterion performance. Fourth, self-confidence ratings have shown significant correlations with performance (Schaefer, Williams, Goodie, & Campbell, 2004) and were therefore worth including as a viable predictor of criterion performance.

Method

Course Selection

Our goal was to identify an officer course with individuals who varied widely in performance-relevant experience and knowledge. To guide our initial selection of courses, we developed seven criteria (Appendix A). We then began examining courses listed in the Army's Training Requirements and Resource System (ATRRS) to identify potential courses. At the same time, we developed interview protocols for use with course personnel. The protocols were designed to verify course information obtained in ATRRS as well as gather information on course prerequisites, officer biodata, and the nature of existing course performance criteria. Interviewing instructors from the potential course list as well as considering the availability of course personnel during the research timeframe resulted in the final selection of the ECCC at Fort Leonard Wood, MO.

Description of the Engineer Captains Career Course. The ECCC is an officer professional development course focused on training captains and promotable first lieutenants for future duties as company commanders and battalion/brigade staff officers. Interviews with course leaders, staff, and SGIs indicated that officers arrive at the course from diverse backgrounds and widely varied experiences and knowledge. The course is 21 weeks long and is mixed gender. It is interesting to note that instructors were aware of subgroup differences between officers with prior enlistment experience (i.e., as noncommissioned officers) and officers without such experience. Namely, instructors indicated that prior enlisted officers tended to have been in uniform much longer and to possess a much more varied set of experiences than non-prior enlisted officers. Given these perceived differences, we included an item in the biodata questionnaire asking whether or not the respondent had prior enlistment experience. In the subjective estimation of the instructors, there is on average a 50/50 split between prior and non-prior enlisted officers.

Selection of Performance Criteria

While our earlier research focused on the relationship between broad cognitive traits (e.g., metacognition) and broad measures of achievement (e.g., overall course average—see Schaefer, Bencaz, Bush, & Price, 2010), using narrower criteria makes it easier to construct good prior knowledge tests. We therefore asked instructors about narrower performance criteria which exhibited large performance differences. The instructors indicated that one such area was defensive planning.

Defensive planning. Instructors indicated that many officers arrived at the course without having practical experience in any aspect of military operations except for counterinsurgency (COIN). Given the nature of current military conflicts, many of the officers'

last exposure to the full range of military operations may have been in their Basic Officer Leader Course (BOLC). Instructors further indicated that the relationships between similar activities are frequently misunderstood. For example, force protection operations such as construction of fortifications or protective emplacements in a forward operating base (FOB) and developing fighting positions in a battle position or company defensive sector may not be related or sufficiently understood by officers entering the course. Instructors also indicated that tactical fundamentals introduced in defensive planning provided a foundation and were built upon in later sections of the course. From this point of view, the defensive planning exam was an important milestone for course progress.

The defensive planning exam draws on basic knowledge of maneuver force tactics, understanding of the military decision-making process, use of orders and graphics, and engineer support of defensive operations in a mid- to high-intensity conflict. The defensive planning exam consists of two parts. The first part is an objectively scored exam consisting of 18 fill-in-the-blank, short answer, and true/false questions. Possible points range from 0 to 60; 'Go' status is achieved by scoring 48 or more points (i.e., 80% or more correct). The second part is graded on the basis of subject matter expertise. While this task can be easily accomplished by course personnel who possess the requisite domain knowledge, we determined that determining the cues underlying such process would be beyond the scope of this project. Thus, we focused on the first part of the exam.

Participants

Seventy-eight (78) ECCC officers and five (5) SGIs participated in this research. Of the 73 officers reporting rank information, 72 were Captains and one was a First Lieutenant Promotable. All SGIs were current Captains or Majors. Four of the SGIs were in the U.S. Army, and one was a U.S. Marine. Of the 73 officers reporting prior service status, 31 had prior enlistment experience and 42 did not. Given the possible existence of subgroup differences (i.e., between individuals with and without prior enlisted service experience), we calculated time-in-grade and time-in-service (both in months) for the groups separately. Time-in-grade for the two groups was similar (prior enlisted officers M = 23.03, SD = 16.65; non-prior enlisted officers M = 17.93, SD = 14.40, t (1, 69) = 1.39, p > .05). However, the prior enlisted officers (M = 136.29, SD = 61.38) had significantly more time-in-service than did the non-prior enlisted officers (M = 56.98, SD = 15.33, t (1, 69) = 7.88, p < .05).

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Procedure

An initial group interview was held with the ECCC instructors. We explained that our research goal was to target a course criterion which displayed large differences in officer performance. During the interview, instructors indicated their confidence that early in the course they could predict who would (not) do well on the criterion. Further discussion indicated that trainer assessments were influenced by general military bearing, communication skills, and confidence. After the defensive planning criterion was chosen, we developed initial drafts of the measures and submitted them to ECCC instructors for review. The instructors agreed that the criterion reflected the knowledge and skills that officers should retain from Engineer Basic Officer Leaders Course (BOLC) and related in-unit training and experiences. It was reflective of the entry level knowledge and skills for the ECCC. With this positive feedback, the instructors suggested only minor editorial changes. Once the recommended changes were made to the instruments, all were approved.

The officer measures were administered to the ECCC officers on the eighth day of instruction. Administration took between one and two hours to complete. Participating SGIs also supplied their predictions of officer criterion performance on the eighth day. The defensive planning exam took place on the twentieth day of instruction. Notably, we were given both digital and hard copies of the criterion exam in advance. This aided greatly our construction of the prior knowledge measure. We return to this point again when we compare the skills tapped by both measures.

Measures

SGI predictions. SGIs were asked to predict how officers (either in their own group or in the course in general) would perform on the criteria. To make both the data collection and later statistical analyses tractable, we did not ask instructors to rank order the officers from absolute highest to lowest. Instead, we asked them to indicate those officers which they felt would fall into the bottom 25%, the middle 50%, or the top 25% of the criterion distributions (Appendix B).

Biodata questionnaire and experience and confidence scales. Officers first read a statement of informed consent and then completed a biodata questionnaire, an experience scale, and a confidence scale (see Appendix C for measures and response frequency information). We considered several factors when selecting biodata items for the questionnaire. For example, instructor interviews indicated that information such as MOS for those with prior enlisted experience and deployment information (e.g., location, duty position, and unit primary mission) were used by instructors to predict officers’ performance. In addition, prior research found that level of education can affect predictor-criterion relationships (Schaefer et al., 2010). In addition, it was found that amount of prior military experience also affected predictor-criterion relationships. This is relevant because, as noted above, ECCC instructors knew that there were subgroup differences in their course, with some individuals having entered the Army as officers and others having had prior enlistment (i.e., non-officer) experience.

The following rationale underlay the use of experience scales. Schmidt, Hunter, and Outerbridge (1986) found that a simple index of experience (e.g., total months/years) within a domain predicted prior knowledge. Given that officers may fill many duty positions during their service, it is difficult to construct such a direct, simple question regarding criterion-relevant experience. However, because asking questions related to time-in-grade and time-in-service require little effort, we included these items in the biodata questionnaire.

Nonetheless, just as prior knowledge is a more targeted and therefore more powerful predictor of criterion performance than general mental ability, perhaps asking targeted (i.e., criterion-related) experience questions would also prove fruitful. We developed the experience scale questions by tapping engineering skills associated with defensive planning. The experience scale questions asked officers to indicate whether or not they had experience with various sources of civilian training, civilian work experience, military training, or military operational experience in tasks such as construction supervision or gap crossing operations (see Question 12 in Appendix C). Checked boxes were summed, and possible responses could range from zero (indicating no relevant training or experience) to four (indicating civilian training, civilian work experience, military training, and military operational experience in the given task). An overall score on the scale was computed by totaling the individual task scores. The overall score could range from 0 to 142 (max individual skill score of 4 multiplied by 32 items).

Officers were also asked to rate their confidence in their ability or readiness to carry out engineer-related tasks. This was done by presenting the officers with a list of Engineer Battlefield Functions (e.g., gap crossing operations, protective emplacements) and asking them to use standard Army training rating scales (T = trained, P = requires training and practice, and U= untrained) to self-assess various competencies. We expected that confidence might be based on prior knowledge, and hence be only indirectly related to criterion performance.

Items from both the experience and confidence scales were developed through a combination of rational judgment and field manual information. Some of the items from the experience scale (e.g., plumbing, masonry) concern activities common in some civilian jobs, but broadly applicable to many engineering contexts. Other items on the experience and confidence scales (e.g., gap crossing operations) are typical military engineering functions listed on pages 3-1 and 3-2 of Chapter 3 of Field Manual 3-34, *Engineer Operations* (Department of the Army, 2009).

Prior knowledge test. The prior knowledge test (Appendix D) was designed to assess the standing of officers with regard to the skills that the course builds upon. It should be stressed that this was a test of prior knowledge, *not* a pretest. An analogy might help to clarify our use of the terms *prior knowledge* and *pre-test*. Assume that you are a Drill Sergeant, teaching Basic Rifle Marksmanship to a group on new Soldiers in Basic Combat Training. If you wanted to give the Soldiers a pretest concerning their marksmanship skills, you would take them out to the range and have them go through the same marksmanship qualification they will be seeing at record fire, at the end of BRM. That is, you would assess how the Soldiers currently stand on the types of problems that you <u>will be teaching</u> them how to handle in the first part of the course. If you were to give them a prior knowledge test, however, the test problems would assess content concerning their general knowledge of firearms, ballistics, and prior experience with rifle

marksmanship before entering Basic Combat Training (BCT), such as hunting or competitive shooting. This type of assessment is looking at their past experiences in the relevant domain. The pretest would give you an idea of how much they already know about what you will be teaching them, and a prior knowledge test would give you an idea of how solid their foundational skills are—the skills you will be expanding and building upon as the course progresses.

The following six factors drove test construction. First, military subject matter expertise guided the construction of items which were judged to be either easier or more difficult in the domain of defensive planning. Second, the test relied on officers being able to use information and apply principles in the correct way, not just to simply recall or list facts and terms. This served to highlight differences in conceptual understanding which might not be brought out by simple recall. Third, the test was designed to provide a measure of officer knowledge without additional resources. Supplemental maps, orders, planning materials, and doctrinal references were not required for successful performance and were not provided with the test. Fourth, the questions on the tests were designed to prevent easy discrimination between correct and incorrect responses. This was accomplished by including common errors as options. Fifth, as noted above, we were given extensive access to the criterion and were able to ensure that the skills emphasized on the criterion were also being measured by the prior knowledge test. Sixth, the prior knowledge test was intended to assess the foundational skills of incoming officers—skills that would be built and expanded on as the course progressed. Therefore, we examined some of the skills taught in the Engineering BOLC—a course that most if not all of the incoming ECCC officers had taken.

The criterion measure emphasized eleven essential competencies of an engineer officer. To enable the reader to gain a feel for how the skills were represented on both the prior knowledge test and the criterion, in Table 1 we provide a crosswalk of the tasks and corresponding skills from both measures. For the most part, the number of questions per skill is roughly equal across the two instruments. While the third task does appear to be an exception, note that all of the questions on the prior knowledge exam tapping that skill are also interrelated with, or present in, other skills. This illustrates something important about using predictors with this kind of complex criterion: a given question can, and probably will, tap multiple skills.

The prior knowledge test measured officer performance on the eleven skills. It did so by placing the officer in the role of a task force engineer, who is planning, supervising, completing planning, and providing staff supervision through the execution of engineer operations supporting the defensive mission of a heavy combined arms battalion (CAB). The test contained situational descriptions, tactical diagrams and sketches, graphical symbols, photos of opposing force (OPFOR) engineer systems, and planning documents.

Table 1
Skill Crosswalk of Prior Knowledge and Criterion Measures

Task	Prior Knowledge Questions	Criterion Questions
1. Basic symbols, control measures, and the tactical situation	7-9, 18, 20	4-6, 13-14, 18
2. Scheme of Obstacles Overlay; intent and effect of obstacles and obstacle groups	1-7, 9-11	1,2,4,13-14
3. Directed, reserve, and situational obstacles and groups	8-11,20	
4. Supported force and engineer organization /task organization	15-19	12, 16
5. Obstacle and fires integration	2,5-7,9-10,12,14	1,3,5,9-10,17
6. Engineer tasks and maneuver commander's intent	7-9, 12,14, 16, 18-20	1-3, 6, 8, 10, 12,15,18
7. Engineer planning and priorities	3,7-11,13-19	1,2,6, 10, 12-13, 15
8. Capabilities of OPFOR engineer organizations, equipment, and tactics	12,13	7, 11
9. High-Value and High-Payoff Targets	12,13	7, 9
10. Developing an engagement area (EA)	7	2, 5, 10
11. Employment of ADAMRAAM and scatterable mine systems	9-11,14	17

The situational details, diagrams, sketches, and symbols provided were all items normally available to a task force engineer from either the CAB order or other military sources. Diagrams and sketches were used to avoid introducing the extraneous, potentially distracting or contentious details of maps or photomaps. The sketches provided unambiguous examples of obstacle groups, defensive schemes, and possible enemy avenues of approach to elicit the officer's understanding of the tactical situation. In this way, whether an officer was successful or not on the prior knowledge test could be attributed to how well he understood (or misunderstood) the subject matter, and not to ambiguities in the test materials.

To do well on the prior knowledge test the officer had to meet the following six requirements. First, the officer had to be able to review, analyze, and make tactical judgments based on the provided planning documents. Second, the officer had to be able to understand and apply the engineer doctrine and principles of defensive planning. For example, the officer needed an understanding of the integration of fires and effects (direct and indirect), maneuver, and obstacles. Third, the officer had to be able to determine the effect and intent of obstacles from graphics. Fourth, the officer had to be able to specify obstacles, obstacle intent, and emplacement construction requirements from commander's intent and guidance. Fifth, the officer had to be able to understand the traits of scatterable mine systems in order to integrate their use into the overall defense plan. Finally, the officer had to understand various capabilities,

characteristics, and missions of OPFOR engineer units and systems in order to assess target and emplacement priorities.

Analysis Strategy

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS 16.0) for Windows, and the alpha level for significance was set at .05 for all tests. As this was an exploratory analysis, all *p* values should be treated with caution. We reported *p* values for the sake of completeness, but did not adjust for family wise error rate. Any confidence in the strength or pattern of the relationships should be tempered in the absence of replication. In analyzing the data, we used the following 3-stage strategy.

Data screening and scale construction. First, all predictor variables were examined for problems like skewed distributions (defined as any item with 80 percent or more of responses falling into a single category or assuming a single value), truncation of range, many response categories with few individuals, or insufficient number of responses. Problematic items were dropped from further analysis and a rationale for the decision was given. Second, all experience measure items were grouped into scales whenever possible. This was done by first examining the individual question descriptives. If no problems were found, then questions were grouped on the basis of common content and format. Cronbach's alphas were then computed to assess scale reliability. Unless removing an item resulted in an improvement in the scale's Cronbach's alpha by .10 or more (e.g., the scales Cronbach's alpha would increase from .80 to .90), all scales were left intact. Potential scale items without item-level statistical problems but which were insufficiently reliable (i.e., scale reliability was too low) were retained as stand-alone predictors.

Correlation and regression. Based on the Schmidt et al. (1986) findings, we had four expectations of the data. (We use the terms 'expectations' and 'expected' because the words 'predicted' and 'predictions' are used frequently throughout the paper to refer to correlational relationships). First, we expected that prior knowledge would significantly predict criterion performance, and that it would in fact be the strongest predictor. Second, we expected that one or more of the experience variables (time-in-grade, time-in-service, experience scales, and biodata variables) would significantly predict prior knowledge, but would not predict criterion performance. Third, we expected that the SGI predictions would significantly predict prior knowledge, but not criterion performance. Fourth, we expected that self-confidence ratings would significantly predict prior knowledge but not criterion performance. This expectation was derived from two sources. To begin with, it seems plausible that confidence ratings would arise (partially) out of experience in a domain. If this is true, then because experience is more directly related to prior knowledge than criterion performance, so too should this pattern hold for any variables derived from experience. Further, the judgment and decision making literature (Schaefer et al., 2004) indicates that although significant correlations between measures of knowledge and self-confidence ratings are often obtained, they are not perfectly correlated and are usually biased in the direction of overconfidence. These expectations, if met, would argue for using prior knowledge (not experience or self-confidence ratings) to predict criterion performance. This is because, as noted in the introduction, Schmidt et al. (1986) found that experience is indirectly related to criterion performance. The experience-criterion relationship is therefore too weak to serve as the basis for making tailored training decisions.

If more than one significant predictor was found, both simultaneous and stepwise regressions were computed. Simultaneous regression gives an estimate of the upper limits of predictability, while stepwise regression estimates the utility of using only a subset of predictors. This is useful information, as combining information from multiple predictors is easy when using statistical software but quite burdensome for the envisioned 'end user' who is unlikely to have access to this type of software. On this account, we felt it was sensible to focus instead on one or two robust predictors of criterion performance.

Predicted versus observed performance categories. The third and final stage focused on illustrating how predictor/criterion information could be translated into 'user friendly' information for course instructors, managers, and other relevant personnel. We approached this problem in the following way.

We followed Cohen's (1992) proposed lower boundary for a large effect size as a correlation of .37 or larger. If such a correlation was found, we then subjected the variables to both Steps 1 and 2 (outlined below). If such a correlation was not found, we skipped Step 1 and proceeded to Step 2.

Step 1: Total score relationships. For these procedures, we visually scanned the predictor and criterion total score frequency distributions to see if naturally occurring break points were present. To foreshadow our results, we found that breaking the prior knowledge and criterion distributions into quartiles and halves was illuminating. (Obviously, different break points might be constructed on the basis of instructor judgment. For example, an instructor might be interested in the top and bottom 10 percent). We then examined the relationship between the predictor and criterion quartiles by constructing a table indicating the number of officers who were (in)correctly classified on the basis of their standing on the predictor variable. We then repeated the tabular procedure, but this time compared the relationship between predictor and 'Go' status on the criterion.

Step 2: Subsets of easy and hard prior knowledge items. For all predictor/criterion pairs we attempted to isolate subsets of the easiest and hardest prior knowledge items and assessed their relationship to total criterion scores. First, crosstabs between the easiest and hardest prior knowledge items and criterion scores were constructed to see if interpretable patterns emerged. Second, the crosstabs were examined to see if there was any evidence of an interpretable relationship between easy/hard item performance and Go/No Go status on the criterion.

Results

To improve readability, we minimized the presentation of statistics in the text. In the case of more complex response patterns, a verbal summary was provided. When the phrase 'most respondents' was used, this meant that more than 80% of officers gave the same response, and by the pre-defined differential response rate rule given above, the item was excluded from further analysis (see Appendix E for descriptive statistics).

Data Screening and Scale Construction

Variables were examined in the order in which they appear in the Appendices and in which they were described above (e.g., SGI predictions, biodata questions, experience and confidence scales, prior knowledge tests, and criterion). When we reported criterion statistics, we did so both for total points and percent correct. This is because the latter makes for easier comparisons between various distributions whose underlying scales may differ in minimum and maximum scores. However, any 'end user' would likely use points.

SGI predictions. Although most SGIs indicated during the interviews their belief that they can intuitively assess current experience and knowledge as well as predict future performance, many were reluctant to make formal assessments when requested. Further, despite initial confidence that accurate intuitive prediction was possible early on, instructors felt that they did not have sufficient time with the officers to form an accurate opinion. The result for both criteria was that fewer than 50% of all Officers had SGI predictions. (There were 13 SGI predictions for prior enlisted officers, and 15 for non-priori enlisted officers.) However, given the possible presence of subgroup differences we retained this variable for further analysis. If subgroup differences were present, it would be helpful to know if SGIs perceived the subgroups differently. One must remember, however, that because the sample was small we cannot be sure of these correlations until the research is replicated with a larger sample.

Biodata questionnaire. All items in the biodata questionnaire were examined for problems. Because many of the biodata variables were dropped in this stage of analysis, we group the variables into 'excluded' and 'retained' categories.

Excluded variables. There were two factors which caused biodata items to be excluded from further analysis. First, most respondents provided the same answers for rank (almost all were Captains), service status (almost all were Active Duty), and military education questions (almost all underwent the Advanced Leader Course). These items were therefore excluded. Second, there were many response categories that were selected too infrequently. We therefore excluded highest rank in prior service, MOS and branch in prior service, and the schools from which any undergraduate degrees were earned.

This also caused the deployment variables to be excluded, replicating a pattern seen in our prior (Schaefer et al., 2010) and current (Schaefer, Blankenbeckler, & Brogdon, 2011) research. There were no significant relationships between the criterion and dates of deployment, location of deployment, duty position, or primary mission. This was due in part to—as stated above—many response categories being too infrequent for statistical analysis. In other cases, response categories were frequent enough but simply did not relate strongly to the criterion. Multiple attempts were made to recode the data into higher-order categories, but all such attempts proved fruitless.

It is worth noting that this does not necessarily preclude this information from being useful for instructors. For example, prior iterations of the course could have broken along cleaner lines with, say, half of the students having a specific deployment experience and the other half not. Such a pattern would lend itself both to instructor perception and statistical

analysis of predictor/criterion relationships. However, the data we do have (combined with prior research, as noted above) does not engender confidence in using such items to inform tailored training decisions.

Retained variables. The retained biodata variables were SGI predictions, time-in-grade, time-in-service, prior service status, level of civilian education, commissioning source, and undergraduate major. The latter two variables were recoded to address small statistical issues. Commissioning source was recoded to ignore the 'other' category as it contained less than 2 percent of the respondents. Undergraduate major, as originally entered, also exhibited the problem of too many categories with too few responses. Therefore, we recoded the undergraduate majors into higher-order categories (e.g., business, business administration, entrepreneurial studies, etc. were all recoded as business degrees). As there is no underlying linearity to the undergraduate major and commissioning source variables, we examined their relationship to criterion performance via analysis of variance (ANOVA).

Experience scale. The potential experience scale asked officers to indicate if they had civilian training or education, civilian work experience, military training, or military operational experience in engineering or related activities like cartography or obstacle emplacement. To reduce demands on memory, the scale simply asked officers to check the boxes indicating whether or not they had the indicated experience. For any given activity, a response could range from 0 (indicating no response options were applicable) to 4 (indicating all response options had been checked). Descriptive analyses of the questions revealed no item-level problems; the Cronbach's alpha of the scale was .94. This scale (i.e., the Defensive Planning Experience (DPE) Scale) was retained.

Confidence scale. The confidence scale asked officers to rate their competence in carrying out Engineer Battlefield Functions like counter-mine and gap-crossing operations. Descriptive analyses of the questions revealed no item-level problems; the Cronbach's alpha of the scale was .93. This scale (i.e., the Defensive Planning Confidence (DPC) Scale) was retained.

Prior knowledge test. Descriptive analysis of the questions revealed no item-level problems, and Cronbach's alpha was .70. This test was retained. (See Table E-3, Appendix E, for item descriptives.)

Criterion. Descriptive analysis of the questions revealed no item-level problems, and Cronbach's alpha was .78.

Correlation and Regression

To ensure clarity of presentation, we first examined whether or not commissioning source and undergraduate major impacted criterion performance for either of the subgroups. Analyses of variance showed that undergraduate major did not significantly impact criterion performance for either prior enlisted (F (4, 26) = .10, p > .05) or the non-prior enlisted (F (4, 37) = 2.55, p > .05). Similarly, commissioning source did not significantly impact criterion performance for either prior enlisted (F (2, 26) = .34, p > .05) or non-prior enlisted (F (2, 38) = 1.20, p > .05).

Next, we examined whether the main variables differed according to prior enlisted experience. Descriptive statistics from this analysis are displayed in Tables 2 and 3 (given that level of civilian education is not a truly continuous variable, it is more informative to give frequency information as in Table 3).

The subgroups were not significantly different in SGI Predictions (t (1, 26) = 1.09, p > .05), DPE Scale (t (1, 70) = .52, p > .05), DPC Scale (t (1, 69) = .47, p > .05), or the Prior Knowledge Test (t (1, 70) = .34, p > .05). However, the non-prior enlisted officers performed significantly better on the Defensive Planning Criterion Exam (t (1, 71) = 2.38, p < .05). In addition, the prior enlisted officers possessed significantly more civilian education (t (1, 71) = 2.52, p < .05) than the non-prior enlisted officers. This was due to the higher rate of graduate schooling for the former group (see Table 3). Therefore, we correlated the variables separately for the two subgroups.

Table 2
Mean Comparisons Between Prior and Non-prior Enlisted Officers

Prior Enlisted Experience	SGI Predictions	DPE Scale	DPC Scale	Prior Knowledge Test (Points)	Prior Knowledge Test (% Correct)	Criterion Exam (Points)	Criterion Exam (% Correct)
Yes	*M*=2.00 *SD*=.58	*M*=14.06 *SD*=10.58	*M*=32.58 *SD*=8.70	*M*=44.50 *SD*=6.08	*M*=66.42 *SD*=9.07	*M*=51.48 *SD*=4.28	*M*=85.81 *SD*=7.14
No	*M*=2.27 *SD*=.70	*M*=12.71 *SD*=11.32	*M*=31.60 *SD*=8.73	*M*=43.98 *SD*=6.51	*M*=65.64 *SD*=9.71	*M*=53.85 *SD*=4.11	*M*=89.74 *SD*=6.86

Table 3
Civilian Education Level of Prior and Non-prior Enlisted Officers

Civilian Education	Prior Enlisted Officers		Civilian Education	Non-prior Enlisted Officers	
	Frequency	Percent		Frequency	Percent
Some College	--	--	Some College	1	2.4
Bachelor	19	61.3	Bachelor	34	81.0
Some Graduate	10	32.3	Some Graduate	7	16.7
Master	2	6.5	Master	--	--
Total	31	100	Total	42	100

Prior enlisted officers. The variables in this analysis were SGI predictions, time-in-service, time-in-grade, highest level of civilian education, Defensive Planning Experience (DPE) Scale, Defensive Planning Confidence (DPC) Scale, Defensive Planning Prior Knowledge Test, and the Defensive Planning Criterion Exam. The results of this analysis are presented in Table 4. However, before proceeding we wish to iterate once again the need for replicating these findings. Such caution is advisable for at least three reasons. First, these findings are based on a small sample of Officers. Second, when conducting so many comparisons some will be statistically significant as a matter of chance. Finally, it is a truism of statistics that some amount of

R^2‘shrinkage’ occurs when applying a regression equation based on one sample to another sample.

Table 4
Correlations for Prior Enlisted Officers

	1	2	3	4	5	6	7	8
1. SGI Predictions	---	.26	.57*	.28	.49	.37	.05	-.43
2. Time-in-service		---	.27	.07	.09	.01	-.01	.08
3. Time-in-grade			---	.18	.31	.36*	.00	.09
4. Civilian Education Level				---	.22	-.07	-.10	-.08
5. DPE Scale					---	.48*	.10	-.09
6. DPC Scale						---	-.06	-.08
7. Prior Knowledge Test							---	.15
8. Criterion Exam (Part 1)								---

Note: **p* <.05. *N*s ranged from 13 (SGI Prediction correlations) to 31.

We now turn to our expectations. First, we expected that prior knowledge would significantly predict criterion performance and that it would be the strongest predictor. This expectation was not met as prior knowledge did not significantly predict criterion performance. Second, we expected that one or more of the experience variables (time-in-grade, time-in-service, experience scale, and biodata items) would significantly predict prior knowledge but not criterion performance. This expectation was also not met. Neither prior knowledge nor criterion performance was significantly predicted by any of the experience variables. In fact, it is quite striking how close all the pertinent correlations are to zero. Third, we expected that the SGI predictions would significantly predict prior knowledge, but not criterion performance. This expectation was not met, as the SGI predictions did not significantly predict either prior knowledge or criterion performance. Fourth, we expected that the self-confidence ratings would be significantly correlated with prior knowledge but not criterion performance. This expectation was also not met. However, the self-confidence ratings were significantly correlated with the experience scale.

Non-prior enlisted officers. Again, the variables were time-in-service, time-in-grade, highest level of civilian education, DPE Scale, DPC Scale, Defensive Planning Prior Knowledge Test, and the Defensive Planning Criterion Exam (Part 1). The results of this analysis are presented in Table 5.

Table 5
Correlations for Non-prior Enlisted Officers

	1	2	3	4	5	6	7	8
1. SGI Predictions	---	-.05	.04	-.11	.00	.24	.35	.11
2. Time-in-service		---	.81*	.13	.38*	.08	.27	.02
3. Time-in-grade			---	.27	.56*	.35*	.34*	.01
4. Civilian Education Level				---	.06	-.17	.25	.24
5. DPE Scale					---	.56*	.55*	.16
6. DPC Scale						---	.22	-.14
7. Prior Knowledge Test							---	.54*
8. Criterion Exam (Part 1)								---

Note: $*p < .05$. *N*s ranged from 15 (SGI Prediction correlations) to 42.

We now turn to our expectations. First, we expected that prior knowledge would significantly predict criterion performance and, further, that it would be the strongest predictor. This expectation was met. Prior knowledge significantly and uniquely predicted criterion performance. Our second expectation was also met: two of the experience variables (time-in-grade and the DPE scale) significantly predicted prior knowledge, but did not predict criterion performance. Third, we expected that the SGI predictions would significantly predict prior knowledge, but not criterion performance. This expectation was not met, as the SGI predictions did not significantly predict either prior knowledge or criterion performance. Fourth, we expected that the self-confidence ratings would be significantly correlated with prior knowledge but not criterion performance. This expectation was not met. However, as with the prior enlisted officers, the self-confidence ratings were significantly correlated with the experience (DPE) scale.

Predicted Versus Observed Performance Categories

As prior knowledge predicted criterion performance only for the non-prior enlisted officers, we conducted this stage of the analysis on those officers only. We examined both the prior knowledge and criterion distributions and found that both variables could be broken into quartiles without unduly distorting the distributions (Table 6).

Table 6
Prior Knowledge and Criterion Quartiles

Prior Knowledge Scores			Criterion Scores		
Points	Percent of Officers	Performance Category (Quartiles)	Points	Percent of Officers	Performance Category (Quartiles)
28-38	23.8	4th Quartile (Bottom)	43-51	23.8	4th Quartile (Bottom)
39-44	26.2	3rd Quartile	52-54	28.6	3rd Quartile
46-48	23.8	2nd Quartile	55-57	23.8	2nd Quartile
49-53	26.2	1st Quartile (Top)	58-59	23.8	1st Quartile (Top)

Note: Non-prior enlisted officers only.

One way of understanding the information shown in Table 7 is to look at the categorization errors. The tendency among this data set seems to be that individuals who score in the bottom half of the prior knowledge distribution also score in the bottom half of the criterion distribution. Similarly, individuals who score in the top half of the prior knowledge distribution also tend to score in the top half of the criterion distribution. To make this clear, we collapsed the quartiles into halves (see Table 8).

Table 7
Match Between Prior Knowledge and Criterion Quartiles

Prior Knowledge Scores	**Actual Criterion Category**				**Row Totals**
	4th Quartile (Bottom)	3rd Quartile	2nd Quartile	1st Quartile (Top)	
4th Quartile (Bottom)	6*	1	3	0	10
3rd Quartile	3	5*	3	9	11
2nd Quartile	1	3	2*	4	10
1st Quartile (Top)	0	6	2	6*	11
Column Totals:	10	12	10	10	42

Note: Entries in cells are number of Captains in that category. Entries with an asterisk indicate correct classifications.

Table 8
Match Between Prior Knowledge and Criterion Halves

Prior Knowledge Scores	**Actual Criterion Category**		**Row Totals**
	Bottom Half (43-54 points)	Top Half (55-59 points)	
Bottom Half (28-44 points)	15	6	21
Top Half (46-53 points)	7	14	21
Column Totals:	22	20	42

To summarize, those who scored in the bottom half of the prior knowledge distribution were more than twice as likely to score in the bottom half of the criterion distribution as in the top half. Similarly, those who scored in the top half of the prior knowledge distribution were about twice as likely to score in the top half of the criterion distribution as in the bottom half.

We next explored the relationship between the quartiles and halves of the prior knowledge distribution to 'Go' status on the criterion (Tables 9 and 10). 'Go' status is defined by course personnel as 80 percent or more of items (i.e., 48 or more points) correct. As Table 9 shows, the 'No Go' rate for officers without prior enlisted experience was extremely low (9.5 %). The data show the same tendency as in Table 8. Of the few individuals who did not achieve a 'Go' on the criterion, three fourths came from the bottom half of the prior knowledge distribution.

Table 9
Match Between Prior Knowledge Quartiles and Criterion Go/No Go

Prior Knowledge Scores	**Criterion Status**		**Row Totals**
	No Go	Go	
4th Quartile (Bottom)	2	8	10
3rd Quartile	1	10	11
2nd Quartile	1	9	10
1st Quartile (Top)	0	11	11
Column Totals:	4	38	42

Note: Entries in cells are number of Captains in that category.

Table 10
Match Between Prior Knowledge Halves and Criterion Go/No Go

Prior Knowledge Scores	Criterion Status		Row Totals
	No Go	Go	
Bottom Half	3	18	21
Top Half	1	20	21
Column Totals:	4	38	42

We then analyzed the relationships between the easiest/hardest prior knowledge items and overall criterion score. (As before, this was done only for the non-prior enlisted officers.) Due to ties for item difficulty, we could not use the five easiest items. Therefore, we cross-tabulated performance on the seven easiest items against total criterion performance. (The seven easiest items were Questions 1, 8b, 12f, 4b, and 12d—see Table E-4, Appendix E.) No discernible pattern between easy prior knowledge items and criterion scores emerged.

Next, we cross-tabulated performance on the five most difficult questions (2, 17, 3d, 4e, and 16) against total criterion performance. This time, a meaningful pattern was revealed. Answering 2 or more of the five most difficult prior knowledge items correlated with scoring 48 points or more on the criterion. By happenstance, 48 or more was also the lower bound for 'Go' status (see Table 11).

Table 11
Hard Prior Knowledge Items and Criterion

Prior Knowledge Test: 5 Hardest Items	Criterion Test	
	0-47.5 points	48-60 points
0-1 Items Correct	4	21
2 or More Items Correct	0	17

Discussion

It is obvious that the relationships among the variables differed markedly between the prior and non-prior enlisted officers. To gain a better understanding of the nature of these differences we first recap how our expectations were met (or not) by the data from the two subgroups. Our first expectation was that prior knowledge would significantly predict criterion performance and do so more powerfully than any other included predictor. This was not true for the prior enlisted officers, but was true for the non-prior enlisted officers. Our second expectation was that one or more of the experience variables would significantly predict prior knowledge but not criterion performance. This was not true for the prior enlisted officers, but was true for the non-prior enlisted officers. Our third expectation was that the SGI predictions would significantly predict prior knowledge, but not criterion performance. This expectation was not met for either subgroup. Our fourth expectation was that self-confidence ratings would

significantly predict prior knowledge, but not criterion performance. This was not met for either subgroup. However, what *was* true of both subgroups is that the self-confidence ratings significantly predicted the experience (DPE) scale ratings.

Considered as a whole, the most important finding is the presence of systematic relationships among experience, prior knowledge, and criterion performance only for those without prior enlisted experience. One possible interpretation of this finding is that the measures behaved differently for the two groups. For example, perhaps the prior knowledge scores or scales exhibited different ranges, variance, or factorial structures of the prior knowledge tests (as revealed by item-difficulties) between the subgroups. This was not the case, however. One striking feature of these results is the similarity between the two subgroups on prior knowledge scores and the scales of experience and confidence. On this basis, the expectation that these subgroup differences are due to markedly different ranges or variances was not tenable. Nor is there evidence that the factorial structure of the prior knowledge test was markedly different between the two subgroups, as the correlation between prior knowledge item difficulties for the two subgroups was .89 (N=67, $p < .001$). The obtained subgroup differences cannot therefore be attributed to either a statistical artifact or structural bias in the prior knowledge test.

How then should we understand these group differences? In considering this question, it is useful to graphically compare the findings of Schmidt et al. (1986) to our non-prior enlisted officers. A more complete comparison is enabled by considering the contribution of supervisor ratings in Schmidt et al. which found the ratings to be significantly correlated with prior experience, but not criterion (work sample) performance. This seems to suggest that while using experience to predict criterion performance is not the *best* choice for predicting performance, it is not necessarily an irrational choice. There are systematic relationships among these variables. The problem is that experience is more indirectly related to criterion-relevant knowledge than is a test of prior knowledge.

Does this same pattern hold for the non-prior enlisted officers? Recall that SGI predictions, as we argued earlier, are a reasonable analog to the supervisor ratings from Schmidt et al. The independent and theoretically grounded evidence for this relationship established by Schmidt et al. provides sufficient reason to justify revisiting this relationship. As Figure 1 shows, the similarities between the Schmidt et al. data and that of our non-prior enlisted officers is striking, with SGI predictions maintaining a substantial relationship with prior knowledge but a weak relation with the criterion, just as found by Schmidt et al. This global pattern of relations again suggests that experience is a rational, if suboptimal, predictor of criterion performance. Schmidt et al. interpreted this to mean that prior knowledge is more accessible than direct criterion performance to supervisors. In other words, through interacting with a supervisee the supervisor may be able to assess whether or not the supervisee can ‘talk the talk’ but not whether they can ‘walk the walk.’ To the extent that ‘talking’ correlates with ‘walking’, the supervisor ratings will be valid predictors of criterion performance.

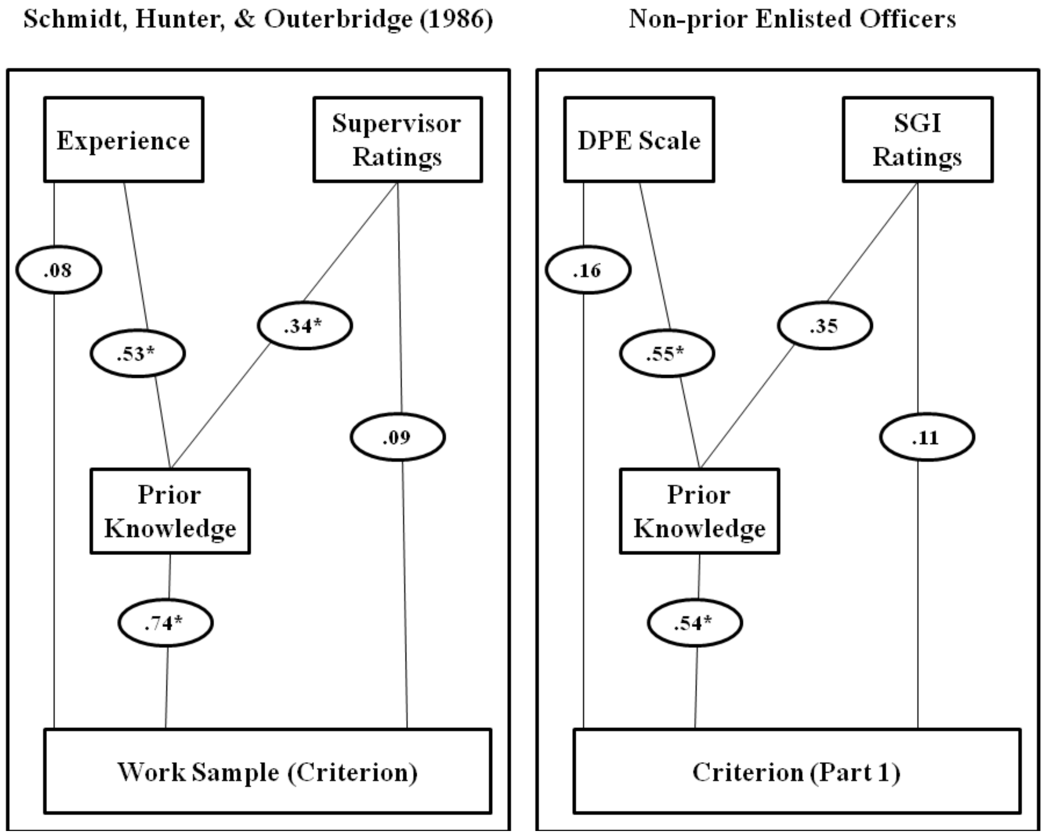

Figure 1. Comparison of Schmidt, Hunter, and Outerbridge (1986) data (*N*=1,474) with non-prior enlisted officer data.
Note.* $p < .05$.

The parallels displayed in Figure 1 are even more compelling when one considers the methodological differences between the Schmidt et al. analysis and the current effort. First, the instruments and methods used in this report and those of Schmidt et al. are not the same. Consider the differences between 'Work Sample' and Defensive Planning Part 1 (i.e., the objectively scored portion) criterion performance. A 'work sample' is a demonstration of proficiency in a work-related task. In contrast, Part 1 criterion performance was an academic test. Second, the supervisor ratings were summary scores derived from ratings on 14 job performance dimensions. The SGIs, in contrast, were merely asked to predict criterion performance. Third, it seems likely that the supervisors had much more time to assess worker skill than the SGIs did to assess officer skill. This is because the average job tenure for supervisees in the Schmidt et al. research was approximately two years as compared to the eight days that the SGIs had to observe their officers in this research. Fourth, the work samples from Schmidt et al. are described as being simulations of important job-related tasks. This suggests that each work sample was a relatively simple task (although many different skills might be tapped across multiple work samples). In contrast, the defensive planning exam involved multiple skills.

The different ways of eliciting 'supervisor ratings' and 'SGI ratings' are also important. Supervisor ratings are usually elicited via a Likert scale, but the SGI ratings here placed less demand upon instructors by simply asking them to place individuals in the bottom quartile,

middle 50 percent, or top quartile of the criterion distribution. Further, the manner in which experience was measured was also quite different. Schmidt et al. examined studies which simply asked individuals how long (e.g., years and months) they had been involved in a given job domain. In this research, we asked specific questions about criterion related activities.

Having established strong parallels between the results for the non-prior enlisted officers and the Schmidt et al. data even in the face of substantial methodological differences, we are now in a position to better understand our obtained subgroup differences. Figure 2 brings into sharper focus the systematic nature of the subgroup differences. Here we focus on the different ways in which the SGI ratings function between the subgroups. Namely, for non-prior enlisted officers, the SGI ratings are reasonably correlated with prior knowledge and weakly, but positively, related to criterion performance. This was not true for the prior enlisted officers. There, the SGI ratings were not significantly correlated with prior knowledge, and negatively and substantially (albeit nonsignificantly, given the small number of SGI ratings) correlated with criterion performance.

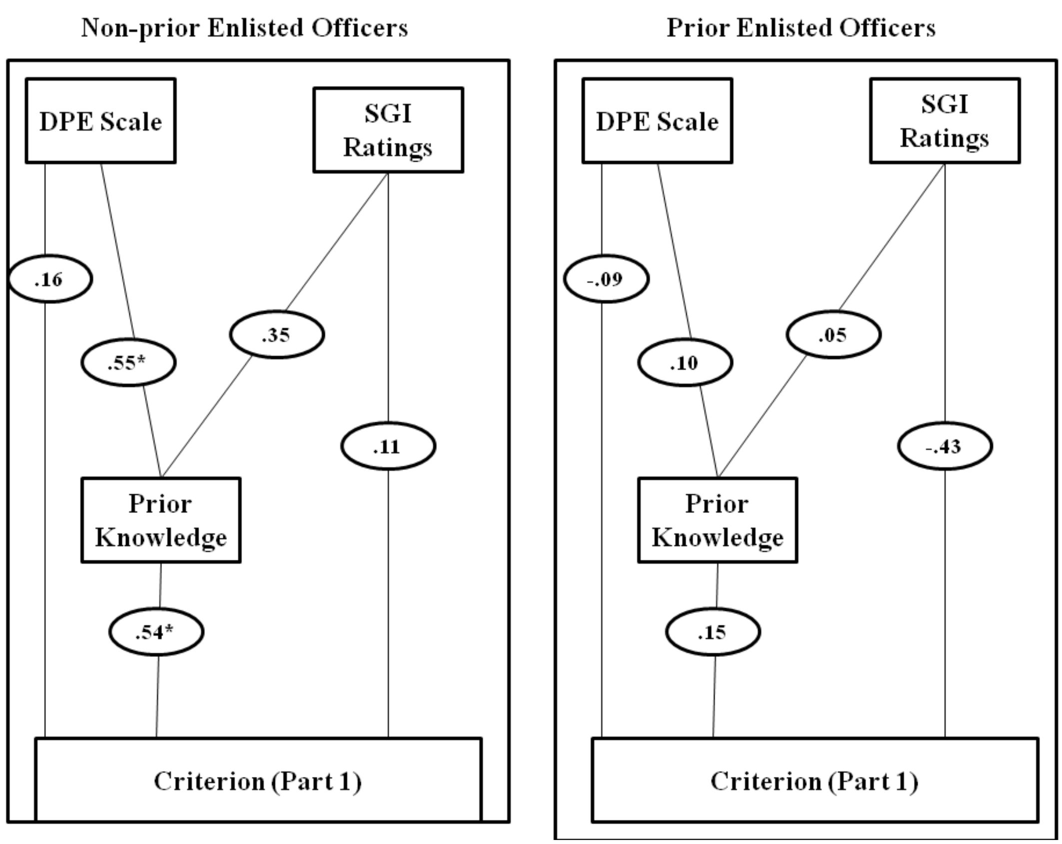

Figure 2. Comparison of non-prior enlisted officer data with prior enlisted officer data.
*Note.** $p < .05$.

What might be causing these subgroup differences? Given the correlational nature of our data any posited reasons must remain speculative. We are more confident that the findings for the non-prior enlisted officers would replicate, given that they themselves appear to be a replication of the model found in Schmidt et al., than we are that the pattern found for the prior

enlisted officers would do so. On the face of it, there seem to be at least four plausible hypotheses regarding this data set.

First, as might be expected given the differences in time-in-service noted earlier, the prior enlisted officers tended to be older. Perhaps the classroom environment required them to build upon their existing prior knowledge in a way that tapped study skills and habits that were stronger in the younger, more recent college graduates (i.e., the non-prior enlisted officers). These differences in study skills need not themselves be correlated with having certain experiences that increase engineering-related knowledge, but might instead become salient only in a classroom environment. Second, motivational factors could be at play. The prior enlisted officers have already (in some cases) had relatively lengthy careers in the military, and may not be looking to 'make their mark' in quite the same way as the younger, non-prior enlisted officers. Their expectations for future promotions or desire to compete for coveted assignments may be lower than their younger peers. Third, the instructors hypothesized that some of the prior enlisted officers might be 'recycles'—that is, this may not have been their first attempt at passing the ECCC. If this is so, then it might be that those individuals possessed enough domain familiarity to do well on the prior knowledge test, but not enough so that their knowledge provided a sufficiently firm foundation for expanding upon the skills they already possessed. Fourth, recall the fact that what SGI ratings we do have appear to be either uncorrelated (in the case of prior knowledge) or even negatively correlated (in the case of criterion performance) with relevant prior enlisted officer variables. This suggests that the two officer populations may have been treated differently during training. Again, however, these are raised as merely plausible hypotheses. Verifying one or more of these would require replications with another sample of ECCC officers using additional measures and perhaps (in the case of the last hypothesis) with a researcher observing instruction.

Recommendations

The fact that the non-prior enlisted officer data so closely mirrors meta-analytic findings based on much larger sample sizes gives us confidence in the reliability of that data set. Further, the fact that the two subgroups were different on not only instruments devised by our research team, but also in how the SGI predictions relate to prior knowledge and criterion performance argues against attributing these subgroup differences to sampling error. These recommendations overlap considerably with those in the companion report on predicting noncommissioned officer (NCO) course performance (Schaefer, Blankenbeckler, & Brogdon, 2011) as there are similarities in the findings. The recommendations are given in the subheadings which follow. Recall that we are interested in predictor measures as they help instructors to determine which individuals require tailored training.

Use Prior Knowledge as a Predictor

When possible, using prior knowledge as a predictor is a good bet. As discussed in the introduction of this paper, prior knowledge captures the joint effects of both mental ability and experience within a domain. This was borne out by the fact that prior knowledge alone significantly predicted performance.

Focus on Narrow Criteria to Maximize Utility of Predictive Information

In our prior research (Schaefer et al., 2010) we focused on broad psychological traits and criteria (e.g., metacognition and class averages). However, given the relative success of using prior knowledge measures as predictors a different tack is advisable.

Constructing prior knowledge measures that attempt to draw on the content of an entire course seem ill advised. First, developing and administering such a measure would take an inordinate amount of time. Second, it is unclear how useful such information would be. If an individual performs poorly on all portions of the test, would the instructor (even if willing) be able to tailor the entire course around that person? Third, such an approach does not lend itself to measurement throughout a course.

It seems more feasible to use ‘mini’ prior knowledge tests prior to blocks of instruction or training on tasks that are important in terms of cost, core objectives, foundational knowledge and skills, or difficulty level. Then decisions can be made regarding what kind of training (if any) is warranted on that particular block of training.

Use Biodata Variables Judiciously

The general types of biodata variables which instructors might use to assess current and future performance were not predictive. This might be because of statistical issues (arguably, the failure of the deployment variables to predict might be because there were too few categories into which responses fell) or because the variables were only indirectly related to criterion performance (as was the case for the experience scale, and even more so for the confidence scale).

However, it seems that using biodata variables to identify subgroup differences is promising. This report and our prior research (Schaefer et al., 2010) identified at least two Army courses in which subgroups exhibited starkly different predictor-criterion relationships. It is encouraging that in both of these courses the subgroups (consisting of differences in military experience) were brought to our attention by the course instructors, indicating that such differences are sometimes suspected by course personnel.

Estimate Total Score and Easy/Hard Item Relationships When Validating Prior Knowledge Predictors

If the correlation between prior knowledge and criterion total score is large enough (using our given rule, .37 or more) then cross-tabulations can be used to generate information usable by course personnel. Such information can then be leveraged to categorize, on the basis of observed probabilities, the likely future criterion performance throughout the entire examined criterion range. Further information can be gleaned by examining the ability of hard (and, in theory, easy) prior knowledge items to predict criterion performance. However, it is important to realize that even a relatively strong correlation of .50 or greater might not reveal itself in the first cross-tabulation that is constructed. It might take several different breakouts of the data (e.g., into thirds, fourths, or fifths) before a clear pattern emerges.

When no large (.37 or greater) total prior knowledge-criterion score correlation is present it is still possible to use sets of difficult items to predict who will do extremely well. As the current data demonstrated, even when a strong correlation *is* present, using subsets of difficult prior knowledge items can be helpful. It is important to realize that the payoff of using difficult items is also heavily dependent on the failure rate on the criterion. The utility of this approach would be much more evident if the criterion failure rate was larger.

Explore the Predictor-Criterion Relationship in Multiple Ways

Determining how to examine the relationship between predictor and criterion involves the simultaneous consideration of the strength and nature of the predictor/criterion relationship, instructor perceptions about what performance is acceptable and what is not (these perceptions may or may not be the same as pre-established ‘Go/No Go’ standards), and what type of tailored training is desired (remedial, mastery, or both).

The predictor/criterion relationship. If there is an unusually strong and reliable correlation between the predictor and criterion (.70 or higher, say) then there are several options open to course personnel. First, relationships between the predictor and criterion distributions should be explored using crosstabs procedures (see Tables 7 through 10). Where to make the cuts can be determined by a variety of factors. For example, simple scanning of the frequency tables may indicate naturally occurring breakpoints. However, cross-tabulating the resulting categories may not reveal a relationship even if a strong overall correlation is present. Given the strong correlation, we know that such a relationship exists. Therefore, it is up to the individual to find the right cut points. (For example, we knew that a strong correlation existed between the prior knowledge test and the criterion exam. When we broke the prior knowledge and criterion measures into thirds, however, that relationship was largely obscured.) How to choose the correct cut points will involve some trial and error. The cut points might be determined by what constitutes Go/No Go on the criterion or by other naturally occurring break points in the predictor and/or criterion distributions.

Whether or not a strong correlation exists, it also useful to explore how well easy and difficult prior knowledge items predict both criterion points and Go/No Go rates. The former is a bit trickier to determine, as the relationship between criterion points and difficult items might also require some trial and error. For example, consider Table 11. It was just happenstance that the relationship between difficult prior knowledge items and criterion points coincided with the Go/No Go boundary. When mapping prior knowledge easy/difficult item performance onto Go/No Go rates, the process a little easier as only the prior knowledge item dimension can vary.

Instructor perceptions of acceptable performance. These perceptions, as noted above, may vary from Go/No Go rates. For example, perhaps the instructor wishes to really hone the skills of his officers. In that case, the instructors internal perception of acceptable behavior may exceed the ‘Go’ rate official standard.

The type of tailored training that is desired. This is not truly independent of the preceding subsection. If tailoring for remedial training alone is the goal, then the individual will

be most interested in the relationships between the predictor and the bottom end of the criterion distribution. This will also probably mean that—if subsets of prior knowledge items are used—the focus will be largely on easy items, as low performing individuals will be the ones most likely to fail such items. Conversely, if the goal is mastery training, then the focus will be on the relationship between the predictor and the upper end of the criterion distribution. If subsets of prior knowledge items are used in that case, the focus will be on the difficult items.

Trade offs in categorization. It is easy to misunderstand that there are tradeoffs involved in categorization. If the goal is to make absolutely sure that only those who truly need remedial training are the ones receiving it, then the risk is that individuals who might have benefited from remedial training are not receiving it. Say for example that an instructor finds that individuals who score in the bottom 25% group on a prior knowledge measure often end up in the bottom 10% group on the criterion distribution. To ensure that only the truly needy receive remedial training the instructor has to decide that only individuals who score in the bottom 10% of the prior knowledge distribution will receive remedial training. In that case, individuals who score between the 10^{th} and 25^{th} percentiles on the prior knowledge test might benefit from remedial training, but fail to receive it.

Conversely, an instructor might be truly interested in mastery training only for individuals who show extreme skill on the criterion. Say further that the instructor has found that individuals who score in the top 25% group on the prior knowledge measure end up in the top 10% on the criterion measure. The instructor realizes that individuals who score in the top 25% on the prior knowledge measure might be able to even further improve their performance by being given advanced training (e.g., more complicated and demanding materials, more practice, etc). However, the instructor wants to make sure that only the individuals in the uppermost top of the prior knowledge distribution will receive such training. In this way, the instructor decides that only individuals who score in the top 10% of the prior knowledge distribution will receive such training. In the mirror image of the above risk analysis, now individuals scoring between the 90^{th} and 75^{th} percentiles on the prior knowledge distribution might benefit from such mastery training, but fail to receive it.

How large such tradeoffs could be will depend on the specifics of the data set and the purpose of the course. But such tradeoffs should be kept in mind when determining how to leverage predictor information in making tailored training decisions.

Conclusions

In sum, making intelligent tailored training decisions based on individual differences is challenging and will require a unique blend of testing and subject matter expertise. The need for testing expertise is obvious, requiring knowledge of test construction and validation procedures. However, the need for subject matter expertise is at least as (if not more) important. Subject matter experts will be required to help test creators determine suitable items for tapping prerequisite skill, knowledge, and experiences, and to help test creators craft predictor measures that address the instructor's needs (e.g., identify individuals who will need assistance, identify individuals who should be challenged or can assist others). In addition, subject matter experts can help test creators determine what kinds of biodatas should be included to test for relevant

subpopulation differences. The subpopulation differences found in our prior (Schaefer et al., 2010) and present research were brought to our attention by course personnel prior to test construction. Developing research teams with the appropriate psychometric and military expertise will require careful investment of resources, further suggesting the need for targeting areas in which tailoring will yield the most benefit.

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Appendix A

Course Selection Criteria

1. Number of officers in each course – Each officer arrives at a course with his/her own KSE, gained over years. Therefore, theoretically, the larger the number of officers in a course, the greater the "potential" for differences in KSE. However, keep in mind that even though there might be a large number of officers, it's possible that a majority will have similar KSE, with only some minority having different KSE. Ensure that selected courses have a large enough "sample size" of officers with differing KSE.

Guideline: Courses with a larger number of officers are more likely to have more differences in KSE.

2. Multiple MOSs – Each MOS (and branch/specialty for officers) of the Army has some unique training requirements, skills and tasks. Therefore, personnel from varied MOSs (branches/specialties) will arrive at a course with differing KSE. However, keep in mind that even though there might be a large number MOSs (branches/specialties), it's possible that a majority of officers will have a common MOS (branch/specialty), with only some minority being a different MOS (branch/specialty). Ensure that selected courses have a large enough "sample size" of officers with different MOS (branch/specialty).

Guideline: The larger the variety of MOSs (and branch/specialty for officers) attending the course, the greater the likelihood of differences in KSE. Also consider that some MOSs (branch/specialties) are so different that those attending a course will increase the likelihood of different KSE. (Example: Soldiers from infantry, armor and even engineer areas are much more similar in many aspects of KSE than Soldiers from chaplain assistant or transportation areas.) An ideal situation would be a course with 2-3 well-represented, qualitatively different MOSs.

3. Course Length (topic/subject) – With the exception of Initial Entry Training (IET) courses, longer courses (more than 45 days) are generally for NCO and officer professional development and are not usually focused on a specific skill or capability. As the level of the course increases (e.g. from ALC [E-6] to SLC [E-7] or from Officer Basic Courses [O-1] to Captains' Career Courses [O-3]) the military KSE will likely increase. Personnel attending the higher level courses will have had more time-in-service and more assignments. However, the overall general, military experience will become more common as the time-in-service increases. Keep in mind that the focus is on the technical skill areas (not soft skills) which will only be a portion of the course.

Guideline: Generally, the shorter courses that are not designed for a specific MOS/branch are more likely to have differences in more general KSE, while the longer professional development courses will have greater differences in specific military assignment KSE areas. Consider only technical portions of professional development courses.

4. Course Content - The nature of the course content ("soft skills" versus technical skills) will have implications for how easily prior knowledge can be measured or how easily performance can be measured. Generally, need to consider the technical task areas for courses where prior knowledge can be measured and avoid attempts to measure "soft skill" areas. Consider blocks of training within courses rather than an entire course, especially if the block of training is a critical technical skill area. Also, officers are more likely to possess differences in KSE in the more technical areas than in the "soft skill" areas.

Guideline: Differences in KSE will generally be more important in courses and blocks of training with structured, sequential technical skill areas that are critical for course completion. Unstructured and non-sequential courses and blocks of training will generally involve more "soft skill" areas and the differences in KSE will have less impact.

5. Prerequisites - Officers attending higher level courses (e.g., Sergeant Major Academy as opposed to SLC or ALC) will generally begin the course with a more common skill level in the area to be trained in the course. If course prerequisites are established and enforced, the likelihood of prior KSE that could impact the course training may be minimal.

Guideline: "Basic" and "intermediate" level courses are more likely than more "advanced" level courses to have officers with differences in KSE that matter.

6. Mandatory course completion – Courses that must be successfully completed to continue Service within the military (e.g., professional development courses versus basic digital skills) are more likely to have officers attending with greater differences in KSE. The intent of the courses is generally to allow officers to "cross-level" the military experiences they have gained so all can move forward with a more common and complete understanding of the military.

Guideline: Mandatory professional development courses are more likely to have measurable differences in KSE than more general subject area courses. Consider only technical portions of professional development courses, not the general "soft skills".

7. Volunteer or selected for course – Generally, courses with attendees who must volunteer (e.g., Airborne) are generally people who perceive a beneficial outcome from the completion of the course, either personal gratitude or professional enhancement. Personnel who are selected for course attendance based on some criteria (e.g., Drill Sergeant) may not have the same perceptions or motivation. Selection criteria will usually consider identifiable areas of KSE. Therefore, it could be presumed that courses with all volunteers are more likely to have a greater difference in KSE than courses with central selection processes.

Guideline: Courses that have both volunteers and selectees have a high possibility of extreme differences of KSE, as well as all volunteer courses.

Other Considerations

1. Number of courses that can be affected – Once potential courses for differences in KSE have been identified, one of the down-select factors should consider the number of similar courses taught at multiple locations who could benefit from the results of this investigation; to provide the Army a "bigger bang for the buck."

2. Decisions as to which courses to examine for this project can be based on the established criteria. In this decision process, interactions between/among criteria should also be considered as an important factor. Since only 5 courses will be selected to visit to gather information on potential KSE to measure, a further consideration is the number of potential courses at an installation that offer potential. That is, if multiple courses offer the same potential for measuring KSE, priority should be given to multiple courses at the same installation in order to maximize benefit of travel.

At the end of this criteria definition process, we will compile the assessment for each criterion for 10 courses (some information will come from web sites and other from telephone calls). When pertinent information is available we will establish a relatively simple check list to apply to the courses (see below). Keep in mind, our purpose in this exercise is <u>to identify the 5 courses we would like to visit</u> to help determine which KSE and what measures would be most appropriate. Something like the following rating scale might work.

Use a rating scale:

0 3 5
(Very slim chance of differing KSE) (Almost certain of differing KSE)

	Selection Criteria						
Course	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Appendix B

Small Group Instructor Predictions

The purpose of this form is to gain insight to your intuition and observations in assessing officer knowledge, skills, and experiences. Many trainers have indicated that they are able to assess officer potential and performance in general and/or for specific subjects and skills early in the course. Please rate the officers in your instructional group and any other officers in the course that your intuition, observations, or impressions have caused you to assess. Place an **X** or ✓ in the appropriate box for Tactics and Defensive Operations.

Place an **X** or ✓ in the appropriate boxes for your assessment.

Officer Roster Number		**Assessment of the Officers Future Academic Performance**			
		Performance on the Defensive Module Planning Examination			
		Top 25%	**Middle 50%**	**Lower 25%**	**Cannot Evaluate**
Officers in My Group					
Other Officers in the Course					

Appendix C

Biodata Questionnaire and Experience Scales

BIOGRAPHICAL INFORMATION

1. Class Number	

2. Rank (circle one)			
1LT	1 LT (P)	CPT	Other

TIG/TIS	**Years**	**Months**
3. Time-in-grade		
4. Time-in-service		

5. Source of Commission (circle one)			
ROTC	USMA	OCS	Other

6. Did you have prior enlisted or warrant service?	YES NO (If yes, see 7.A)	
6.A. Highest Rank:	MOS:	Service/Branch:

7. Service Status (circle one)		
Active Duty	National Guard	US Army Reserve

8. Military Education Level (circle all that apply)			
BNCOC/ALC	ANCOC/SLC	WOC	BOLC

9. Civilian Education Level (circle highest level of education)			
Non HSG	GED	HS Diploma	Some College (no degree)
Associates Degree	Bachelors Degree	Graduate Work	Master's Degree
9. A. If undergraduate degree, state the degree/major/school:			
9.B. If graduate degree, state the degree/major/school:			

10. Deployment History (Most recent first)

Date: From	Date: To	Iraq	Afghan	Other	Duty Position	Unit Primary Mission
e.g. Jun, 2007	***Jul, 2008***	***X***			***Platoon Leader***	***Route Clearance***

(Continue if more deployment experience)

11. Assignment History (Most recent first)					
Date: From	Date: To	Battalion	Brigade	Division	Duty Position
e.g. Feb, 2009	***Apr, 2010***	***EGR CO/BSTB***	***4 BCT***	***82 Abn Div***	***XO***
Feb, 2007	***Jan, 2009***	***EGR CO/BSTB***	***4 BCT***	***82 Abn Div***	***PL***

(If prior service, provide 3 years prior to commissioning.)

<table>
<tr><th colspan="6">12. Individual skills training and experience (check all that apply)</th></tr>
<tr><th colspan="2" rowspan="2">Skill or Expertise</th><th colspan="4">Source(s) of Education, Training, and Experience</th></tr>
<tr><th>Civilian Training and/or Education</th><th>Civilian Work Experience</th><th>Military Training</th><th>Military Operational Experience</th></tr>
<tr><td colspan="2">carpentry, roofing, & framing</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">plumbing</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">masonry</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">paving, road building, and repair</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">construction equipment operation</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">construction supervision</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">precision survey</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">cartography</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">photogrammetry</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">imagery interpretation</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">terrain analysis</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">soil analysis</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">map production</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">water purification</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">water distribution</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">waste disposal</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">physical security</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">countermobility planning</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">obstacle construction & emplacement</td><td>lethal</td><td></td><td></td><td></td><td></td></tr>
<tr><td>non-lethal</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">mobility planning</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">mobility operations</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">obstacle breaching & reduction</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">counter-IED operations</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">gap crossing operations</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">bridging and river crossing ops</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">fighting & protective emplacements</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">camouflage & concealment</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">deception operations</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">damage assessment</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">damage control</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">preparing construction materials</td><td></td><td></td><td></td><td></td></tr>
</table>

13. Knowledge and Skills Proficiency. Provide a self-evaluation of your competency to execute the following engineer battlefield functions. (Check the most appropriate answer.) **<u>Trained</u> = I could successfully plan and supervise execution of this function.** **<u>Require Training & Practice</u> = I would be capable of correctly performing most planning and execution aspects of this function.** **<u>Untrained</u> = I require additional training to be able to correctly perform the planning and execution aspects of this function.**			
<u>Engineer Battlefield Function</u>	**Trained**	**Require Training & Practice**	**Untrained**
Mobility			
Counter-mine/IED/ obstacle operations			
Gap crossing operations			
River crossing operations			
Construction/clearing of roads and trails			
Forward aviation combat engineering			
Countermobility			
Mine operations			
Obstacle development			
Survivability			
Emplacements and fighting positions			
Protective emplacements			
Protected support facilities			
Camouflage			
Concealment			
Deception			
General Engineering			
Line of Communication (LOC) construction/repair			
Logistics – support facilities construction			
Area damage control			
Construction – materials production			
Civic Action Projects			
Security assistance training and assistance teams			
Topographic Engineering			
Terrain analysis			
Precision survey			
Map production			

Appendix D

Defensive Planning Prior Knowledge Test

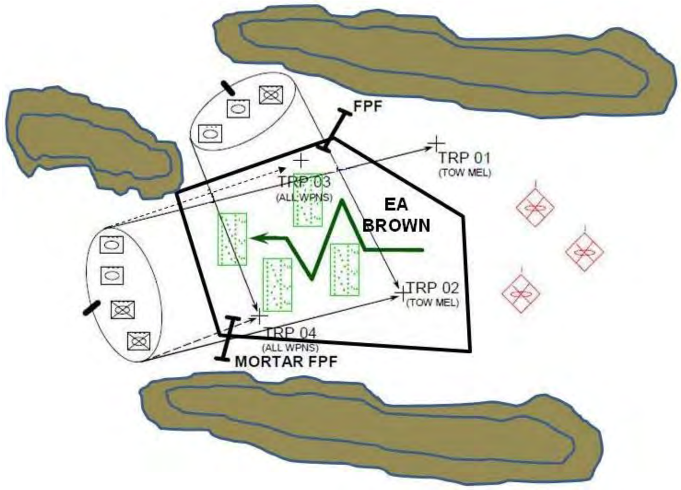
Percent of individuals who correctly answered a question is located below each item stem?. Non-prior enlisted denoted by NPE, prior enlisted denoted by PE.

General Instructions: These questions **<u>will not</u>** be used for academic evaluations in Engineer Captains Career Course. They will only be used to assess your knowledge and skills on selected subjects as you arrive. If you are **uncertain** of the correct answer, **leave it blank**. Record only those answers that you believe are correct.

GENERAL SITUATION: The Peoples Republic of Canto (PRC), without provocation attacked Blount and seized control of the Soto Region. In response, the United States deployed JTF Kilo, consisting of II Corps, the 9th Infantry Division (MECH) (-), the 16th Infantry Division (AASLT), and sustainment and support units as part of a NATO and regional coalition. Coordinated attacks of II Corps supported by coalition air have virtually destroyed the PRC's 7th Armored Division and defeated the 14th Infantry Division (Heavy) and 27th Armored Brigade (Sep). The 4th HBCT, 9th ID has been in pursuit of fleeing remnants of 14th Infantry Division. However, intelligence sources and reports from the 4th HBCT's ISR Squadron, 4/88th Cav, indicate that additional PRC forces have massed at the border and fresh enemy reconnaissance forces have crossed into Blount. 4th HBCT has ordered 3-19 INF BN (CAB) to establish an area defense and block PRC counterattacks while the remainder of 4th HBCT and the 9th ID move forward. The 3-19th INF BN (CAB) has been reinforced with additional engineer assets from the 377th Maneuver Enhancement Brigade.

SPECIAL SITUATION: You have just arrived in the theater of operations and have been assigned to 4th HBCT, 9th ID. Upon reporting to the HBCT Main Command Post (CP), you were told that the previous TF Engineer for 3-19 INF (CAB), has been injured and evacuated. You are to immediately take his place. Upon arrival at the 3-19th INF BN's Main CP, you find the staff completing planning and maneuver units are occupying initial positions. The XO and S3, both pleased to see you, tell you to review the TF Engineer's notes and plans and prepare to coordinate defensive preparations.

You find early planning sketches that correspond to the defensive course of action graphics. Engagement Area (EA) Brown was identified in initial planning as critical to the Battalion's defense. Answer questions 1 – 2 referring to the sketch below:


FPF
TRP 01
(TOW MEL)
TRP 03
(ALL WPNS)
EA
BROWN
TRP 02
(TOW MEL)
TRP 04
(ALL WPNS)
MORTAR FPF

1. What was the intent of the obstacle group designed for EA Brown? (Circle the correct answer.)

[Question 1: NPE 57.1% correct, PE 70 % correct]

A. Slow the enemy attack to permit the defender time to acquire, target, and destroy enemy vehicles and formations <u>and</u>/<u>or</u> delay the enemy force to permit the friendly force to break contact and disengage. (Fix Effect)

B. Break up enemy formations and tempo, allowing some elements of the enemy force to bypass obstacles while other elements deploy early and breach. (Disrupt Effect)

C. Divert the enemy from an avenue of approach and allow or force their formations bypass into a desired direction or a prepared engagement area. (Turn Effect)

D. Create a situation in which massed fires and obstacles halt the attack along an avenue of approach or prevent the enemy from passing through the engagement area. (Block Effect)

E. All the above are supported by the obstacle group in EA Brown.

2. This obstacle group should be integrated with the effects of direct and indirect fires and enhance these effects. What characteristics of defensive fires and effects should the obstacle group in EA Brown enhance? (Circle the correct answer.)

[Question 2: NPE 33.3 % correct, PE 60% correct]

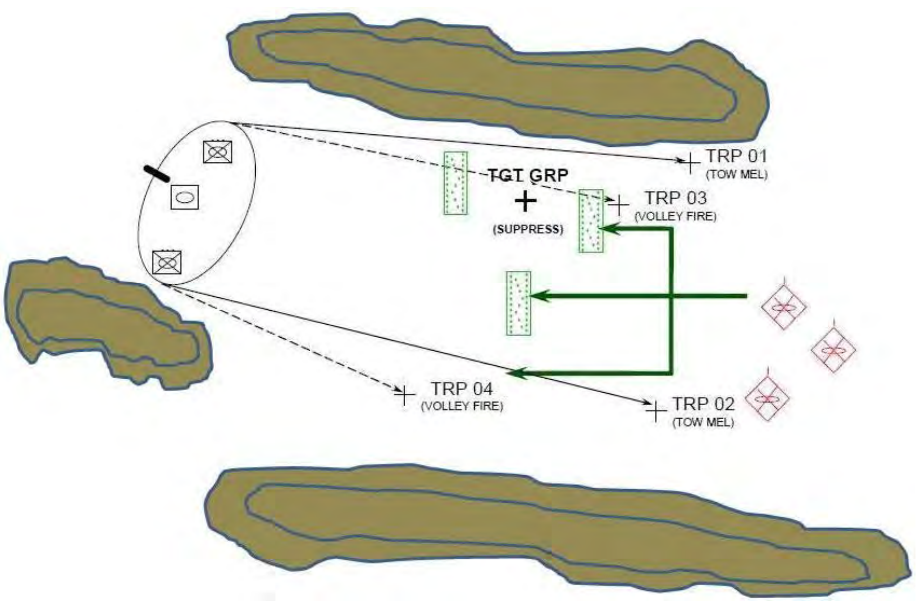
A. The massing of direct and indirect fires across the entire enemy avenue of approach to halt the enemy advance and attrite his forces.

B. The massing of fires into restrictive terrain or anchor points for obstacles to prevent bypass or breach of obstacles.

C. The impact of interlocking fires and fires from varied positions into channelized enemy formations, forcing them to fight in multiple directions simultaneously.

D. None of the above would be characteristics of fires in this EA.

Disruptive obstacle groups were considered in the forward area of the defense. The obstacle group sketch below is an example of initial planning in the CAB's security area. Answer questions 3 – 4 referring to the sketch below and your knowledge of disruptive obstacles in the defense.



3. From the characteristics and planning considerations below, select those which are valid for planning obstacles and obstacle groups to facilitate the disruptive effect. (Place an “X” in the blanks for all that apply; one or more responses are correct.)

[Question 3a: NPE 73.8 % correct, PE 60.0% correct]
[Question 3b: NPE 40.5 % correct, PE 23.3% correct]
[Question 3c: NPE 50.0 % correct, PE 26.7% correct]
[Question 3d: NPE 23.8 % correct, PE 33.3% correct]

____ A. The obstacle(s) should attack (influence) approximately half of the expected enemy avenue of approach.

____ B. Obstacles should be more easily detected as the enemy nears them.

____ C. Initial obstacles should appear more complex than those in the desired direction of enemy movement.

____ D. Obstacles should require less extensive resources (labor, time, equipment, materials, etc.).

4. What is the desired effect of disruptive obstacles in the security area? (Circle all that apply; one or more responses are correct.)

[Question 4a: NPE 57.1 % correct, PE 53.3% correct]
[Question 4b: NPE 97.6 % correct, PE 96.7% correct]
[Question 4c: NPE 73.8 % correct, PE 83.3% correct]
[Question 4d: NPE 50.0 % correct, PE 56.7% correct]
[Question 4e: NPE 9.5 % correct, PE 16.7% correct]

A. Divert the enemy off his intended avenue or approach or attack routes and on to the avenues that best support our scheme of maneuver and his destruction.

B. Halt the enemy advance.

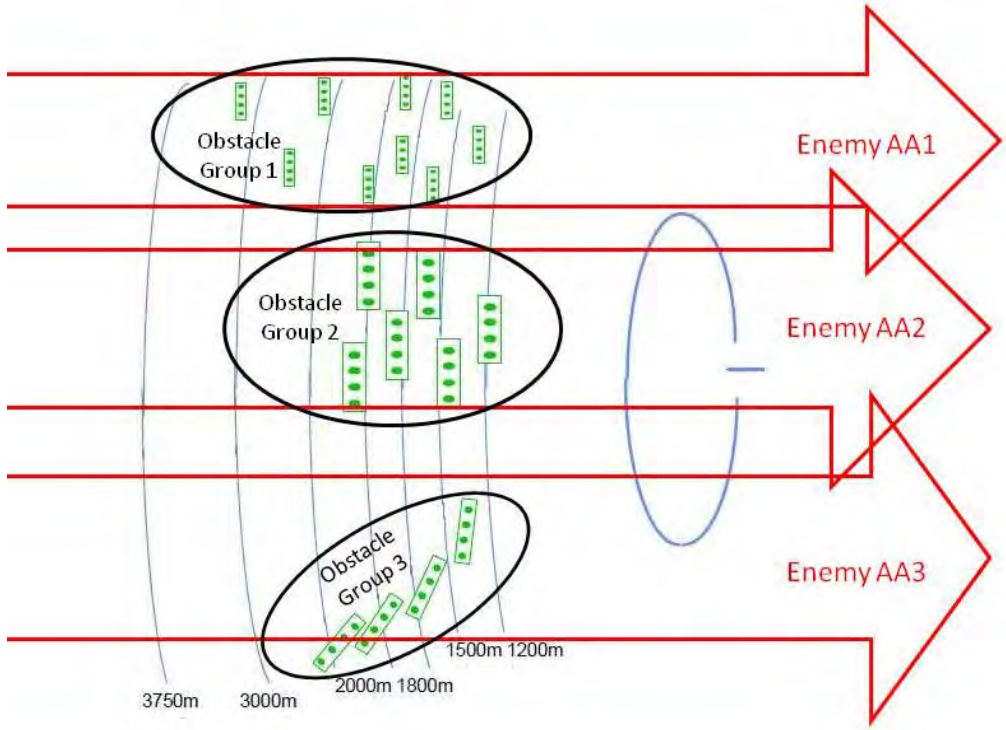
C. Break up the tempo of the attack by forcing some enemy elements to deploy and breach early.

D. Slow the attack to permit time for targeting and destruction of enemy forces or friendly force disengagement and repositioning.

E. Deceive the enemy as to the exact locations of our defenses.

F. Delay some elements of the attacking force, disrupting command and control of the attack and causing piecemeal commitment of enemy forces.

The example below depicts varied obstacle groups along enemy avenues of approach through a company position. Normally, a company-team will have the mission to cover only one or two obstacle groups in the defense. Answer questions 5 – 6 referring to the sketch below:



5. Match the Obstacle Groups with the desired effect that the commander desires along each enemy avenue of approach. (Enter the letter for the obstacle effect beside the Obstacle Group. Obstacle effects may be used more than once or not at all.)

[Question 5-1: NPE 45.2 % correct, PE 33.3% correct]
[Question 5-2: NPE 66.7 % correct, PE 66.7% correct]
[Question 5-3: NPE 92.9 % correct, PE 90.0% correct]

____ Obstacle Group 1

____ Obstacle Group 2

____ Obstacle Group 3

A. Disrupt Effect

B. Obstruct Effect

C. Turn Effect

D. Block Effect

E. Fix Effect

6. Along which Enemy AA would you expect to find the greatest concentration of planned massed direct and indirect fires integrated with the obstacles? (Select one answer.)

[Question 6: NPE 42.9 % correct, PE 50.0% correct]

____ A. Avenue of Approach 1

____ B. Avenue of Approach 2

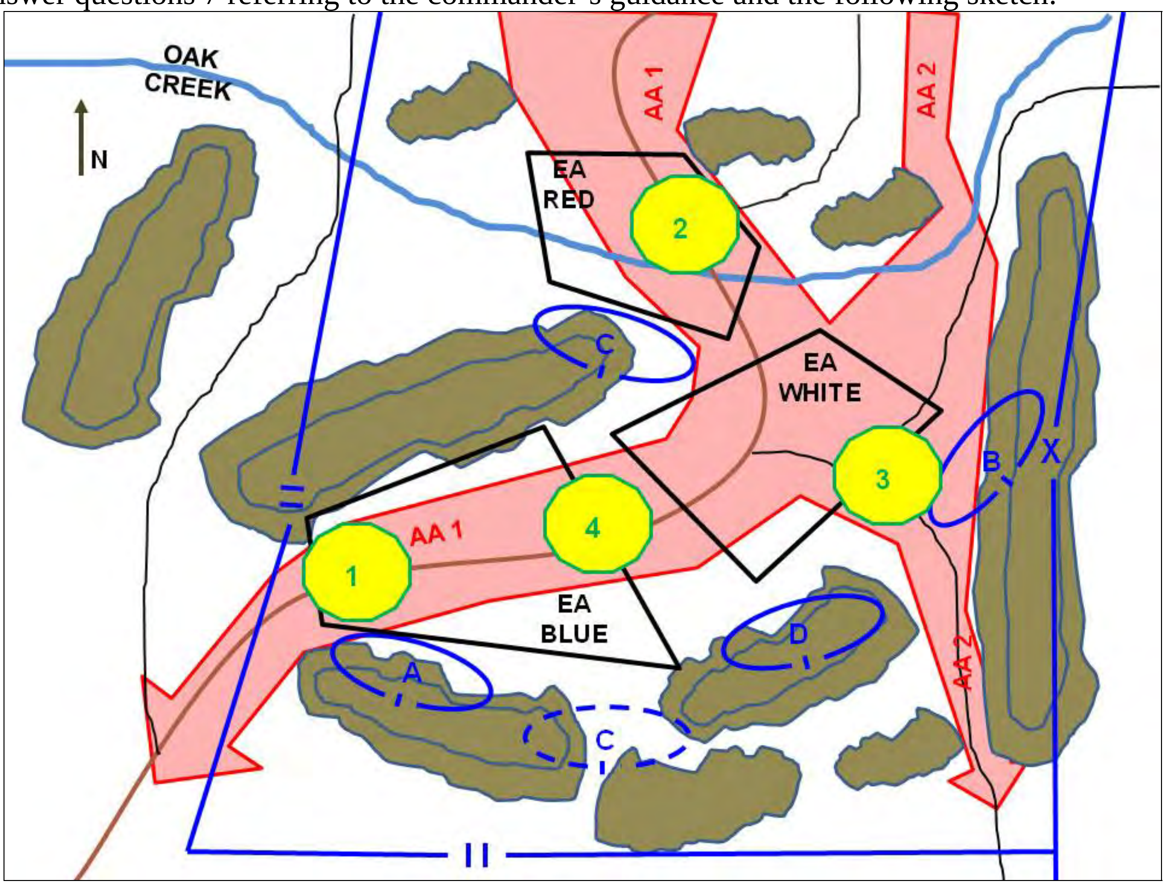
____ C. Avenue of Approach 3

____ D. Planned direct and indirect fires would be equally distributed across all AAs.

The selected Course of Action for the CAB defense is indicated in the next sketch. The BN CDR has provided the following guidance for the conduct of the defense and the engineer obstacle effort:

"I want to stop and destroy the enemy in EA Blue. However, we must initially slow his advance as he enters our sector and deceive him as to the position and strength of our defenses. Be sure that we can get C Co. out of their initial positions and back into the depth defenses. As the enemy enters our defenses, force him into our kill zones and prevent his use of other approaches. Finally, as he enters EA Blue slow his movement rate and attrite him heavily, then hold him while we finish the fight and complete the destruction of his forces."

Answer questions 7 referring to the commander's guidance and the following sketch:

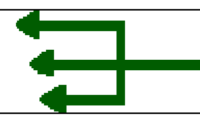
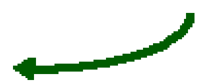
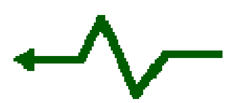
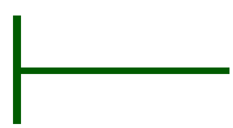


7. The BN CDR has approved the priorities for the obstacle groups indicated by the green numbers on the yellow polygons. Indication of the desired obstacle effect should:

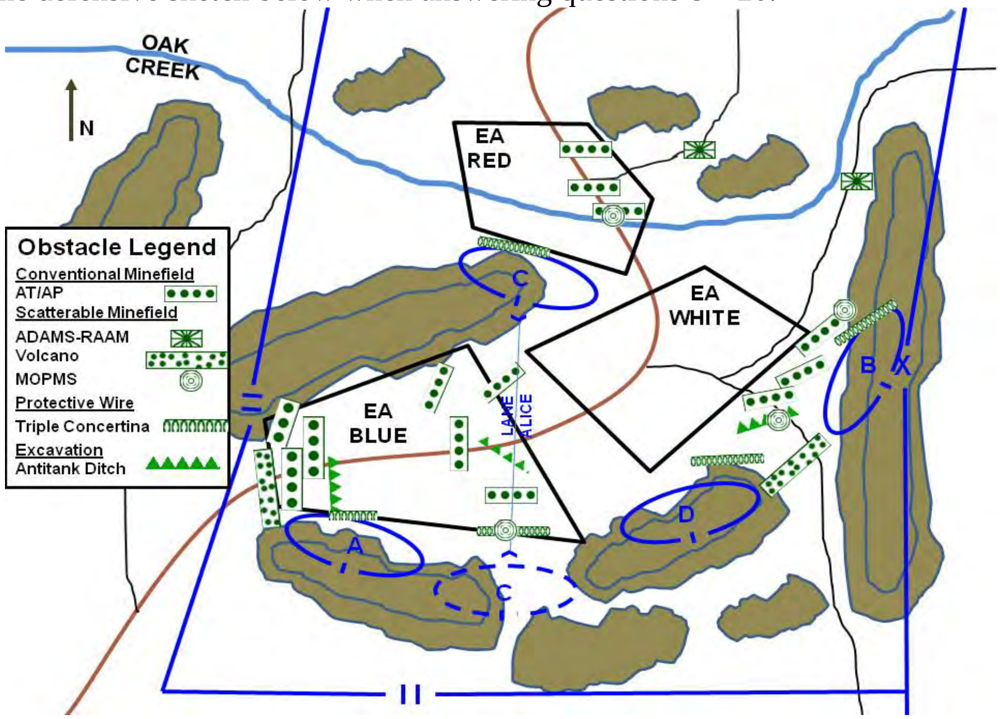
- Drive integration of obstacles and fires
- Focus subordinate and supporting staff fire planning
- Focus the obstacle effort
- Multiply the effects of firepower

Based on the commander’s guidance for obstacles and priorities, what obstacle effects symbol should be associated with the obstacle groups and priority numbers indicated in the situation overlay above? (Match the letter of the effects symbol to the obstacle group priority number. Symbols may be used more than once or not at all.)

[Question 7-1: NPE 76.2 % correct, PE 76.7 % correct]
[Question 7-2: NPE 45.2 % correct, PE 53.3 % correct]
[Question 7-3: NPE 64.3 % correct, PE 73.3 % correct]
[Question 7-4: NPE 59.5 % correct, PE 53.3 % correct]

<table>
<tr><th>Obstacle Group Priority</th><th>Effects Letter</th><th>Effect Symbol</th></tr>
<tr><td rowspan="6">_____ 1.
_____ 2.
_____ 3.
_____ 4.</td><td>A</td><td></td></tr>
<tr><td>B</td><td></td></tr>
<tr><td>C</td><td></td></tr>
<tr><td>D</td><td></td></tr>
<tr><td>E</td><td></td></tr>
<tr><td>F</td><td></td></tr>
</table>

As defensive preparations have progressed, you have tracked obstacle completion. Obstacle groups are emplaced as indicated. Scatterable minefields are planned and approved as situational or reserve obstacles. Lane Alice is has been created to facilitate rapid repositioning C Company. Refer to the defensive sketch below when answering questions 8 – 20.



8. Lane Alice has been constructed to provide a double lane vehicular route through the obstacle group in the eastern part of EA BLUE. From the list below select the characteristics that should define LANE ALICE. (Circle all that apply; one or more responses are correct.)

[Question 8a: NPE 57.1 % correct, PE 60.0 % correct]
[Question 8b: NPE 100.0 % correct, PE 96.7 % correct]
[Question 8c: NPE 50.0 % correct, PE 63.3 % correct]
[Question 8d: NPE 38.1 % correct, PE 36.7 % correct]
[Question 8e: NPE 52.4 % correct, PE 50.0 % correct]
[Question 8f: NPE 69.0 % correct, PE 73.3 % correct]
[Question 8g: NPE 73.8 % correct, PE 80.0 % correct]

A. Lane Alice will be a clear route through all obstacles.

B. Lane Alice should be at least (1) one meter wide with tracing tape down the center.

C. Lane Alice should be at least (8) eight meters wide.

D. Lane Alice should be at least (15) fifteen meters wide.

E. Lane Alice should be straight and follows a proscribed azimuth making marking optional along the lane.

F. Specific responsibilities will be identified for closure of Lane Alice and execution of the associated reserve targets.

G. Lane Alice should include sudden turns or “traps” to prevent enemy exploitation of the route.

9. The CAB Commander has planned several scatterable minefield obstacles as situational or reserve obstacles using area-denial artillery munitions and remote antiarmor mines [ADAMS-RAAM], modular pack mine system [MOPMS], and Volcano. All minefields have been approved by the 9th ID. Based on your review of the situation, how are scatterable minefield obstacles in or near EA BLUE and EA WHITE being employed? (Circle the correct response.)

[Question 9: NPE 50.0 % correct, PE 56.7 % correct]

A. To separate attacking enemy echelons.

B. To shape the battle space for the deep battle.

C. To defeat or repair expected breach or by-pass efforts or close a lane.

D. To emplace additional obstacles that are production shortfalls (supporting engineers were not able to accomplish due to priorities, time, materials, or equipment).

10. The Volcano minefields south southeast of EA WHITE and west of EA BLUE are situational obstacles. Given the commander's intent and priorities for these obstacle groups, what are some of the basic principles for planning, preparing, and executing situational obstacles that should be followed? (Circle all that apply; one or more responses are correct.)

[Question 10a: NPE 50.0 % correct, PE 76.7 % correct]
[Question 10b: NPE 85.7 % correct, PE 90.0 % correct]
[Question 10c: NPE 38.1 % correct, PE 46.7 % correct]
[Question 10d: NPE 64.3 % correct, PE 56.7 % correct]
[Question 10e: NPE 88.1 % correct, PE 76.7 % correct]

A. The obstacles should be fully integrated with friendly direct and indirect fires and effects.

B. Specific friendly or enemy situation triggers (criteria) should be established for employment of these targets.

C. A Volcano launch system should be identified and munitions dedicated for both targets.

D. Both targets should be executable simultaneously without degrading the effects of the other.

E. Volcano should only be used for situational targets since they are always time sensitive or short-notice requirements.

11. MOPMS have been planned to defeat or repair expected enemy breach or by-pass efforts, close lanes, and reinforce existing obstacles. Identify characteristics of MOPMS that makes them ideal for these missions. (Circle all that apply; one or more responses are correct.)

[Question 11a: NPE 66.7 % correct, PE 66.7 % correct]
[Question 11b: NPE 71.4 % correct, PE 56.7 % correct]
[Question 11c: NPE 85.7 % correct, PE 83.3 % correct]
[Question 11d: NPE 47.6 % correct, PE 60.0 % correct]
[Question 11e: NPE 81.0 % correct, PE 73.3 % correct]

A. Small size and weight make MOPMS ideal for backpacking long distances.

B. Mines have a standard 4-day (96-hour) lethal duration after employment.

C. Only when triggered by a direct wire link can MOPMS self-destruct (SD) times be recycled and dispersed mines command-detonated.

D. Using the M71 remote-control unit, an operator can control up to 15 MOPMS or groups out to a range of 1,000 meters.

E. Mines can be recovered and reloaded for use if not detonated.

12. Based on the terrain, the friendly defense plan, and the obstacle/barrier plan, which enemy combat engineer systems shown below should you recommend for consideration as high-payoff targets (HPTs) for the CAB defense both north and south of Oak Creek? (Circle all that apply; one or more responses are correct.)

[Question 12a: NPE 78.6 % correct, PE 93.3 % correct]
[Question 12b: NPE 83.3 % correct, PE 90.0 % correct]
[Question 12c: NPE 47.6 % correct, PE 63.3 % correct]
[Question 12d: NPE 97.6 % correct, PE 100.0 % correct]
[Question 12e: NPE 59.5 % correct, PE 80.0 % correct]
[Question 12f: NPE 100.0 % correct, PE 96.7 % correct]
[Question 12g: NPE 95.2 % correct, PE 96.7 % correct]

A. Armored mine clearing launcher systems

B. Tanks fitted with mine rollers and plows

C. Tank launched bridges

D. Dump trucks

E. Armored route clearing tractors

F. Road graders

G. None of the above. In this situation HPTs should be limited to Tanks and Infantry Fighting Vehicles (IFVs).

13. During offensive operations, how would the enemy employ armored mine laying systems like the GMZ pictured below? (Circle all that apply; one or more responses are correct.)

[Question 13a: NPE 64.3 % correct, PE 56.7 % correct]
[Question 13b: NPE 69.0 % correct, PE 66.7 % correct]
[Question 13c: NPE 85.7 % correct, PE 73.3 % correct]
[Question 13d: NPE 38.1 % correct, PE 46.7 % correct]

A. Hold them in reserve until his forces assume the defense or are ordered to defend.

B. As an element of a mobile obstacle detachment, emplace hasty mine fields along a vulnerable flank to block blue force counter attacks.

C. Employ them in their secondary role as infantry carriers for support troops or to haul barrier materials or supplies.

D. Employ them as an element of the antitank reserve to block and destroy blue force counterattack forces that penetrate the attacking formations or threaten supply routes.

14. Two ADAMS-RAAM obstacles have been integrated into the maneuver, fires, and obstacle plans. Additional munitions have been made available for these targets. What are some of the considerations when planning ADAMS-RAAM obstacles? (Circle all that apply; one or more responses are correct.)

[Question 14a: NPE 81.0 % correct, PE 66.7 % correct]
[Question 14b: NPE 57.1 % correct, PE 50.0 % correct]
[Question 14c: NPE 97.6 % correct, PE 83.3 % correct]
[Question 14d: NPE 45.2 % correct, PE 56.7 % correct]

A. These targets will be fired by organic systems of the CAB and will compete for other requests for indirect fires and expend critical munitions.

B. These munitions will be fired by a combination of organic CAB assets and supporting field artillery units based on the scheme of indirect fires and the availability of delivery systems.

C. Triggering the target and delivery of planned ADAMS-RAAM minefields is the sole responsibility of the Task Force Engineer.

D. Once approved, the Fire Support Element in coordination with the assigned Field Artillery delivery unit will be responsible to determine the technical aspects of delivery – range-to-target, time, rounds per aim point, number of aim points, etc.

15. Available engineer (sapper) platoon hours have been used emplacing minefields and wire obstacles and some organic engineer excavation resources (ACEs and HMEEs) have been used constructing the three antitank ditches. Given the modularity of the HBCT and the CABs, how many vehicle fighting positions (to protect M1s and M2s) would be required for the CAB companies fighting pure in the defense? (Circle the correct answer.)

[Question 15: NPE 64.3 % correct, PE 76.7 % correct]

A. 9 C. 14

B. 12 D. 19

16. Uninterrupted delivery of fires and smoke are critical to the plan. The 3-19th INF (CAB) commander has directed that while protection of direct fire systems is critical, protecting the CAB's mortar platoon is absolutely essential. He wants both **primary** and **alternate** positions prepared and all of their organic vehicles to be hull down. How many hull down positions must be added to your survivability plan? (Circle the correct answer.)

[Question 16: NPE 0.0 % correct, PE 10.0 % correct]

A. 6

B. 8

C. 10

D. 12

17. Five (5) D7 bull dozers have been attached for the mission. What would be the most likely source (or sources) for these and other excavation resources? (Circle the correct answer.)

[Question 17: NPE 31.0 % correct, PE 33.3 % correct]

A. The heavy equipment platoon of the 4th HBCT's organic combat engineer battalion

B. The heavy construction company, organic to the combat engineer battalion of the 9th ID (MECH).

C. An engineer battalion assigned to the maneuver enhancement brigade supporting the 4th HBCT, 9th ID, or II Corps and the JTF.

D. The general headquarters (GHQ) supporting II Corps and the JTF

18. Identify factors that you, as the TF Engineer, should consider when developing the work plan and obstacle execution matrix for the available engineers and excavation resources? (Circle all that apply; one or more responses are correct.)

[Question 18a: NPE 95.2 % correct, PE 96.7 % correct]
[Question 18b: NPE 90.5 % correct, PE 86.7 % correct]
[Question 18c: NPE 83.3 % correct, PE 93.3 % correct]
[Question 18d: NPE 42.9 % correct, PE 33.3 % correct]
[Question 18e: NPE 81.0 % correct, PE 90.0 % correct]
[Question 18f: NPE 71.4 % correct, PE 63.3 % correct]

A. Time available to prepare the defense

B. Construction materials or munitions required and available

C. Priorities established by the maneuver commander

D. Fuel consumption rates for all excavation systems, troop carriers, and prime movers.

E. Excavation or emplacement systems available and their projected operational readiness rate(s)

F. Travel time between primary work sites

19. The S2 has indicated that the enemy will be capable of attacking six (6) hours, sooner than anticipated. There is not sufficient time to excavate all survivability positions planned. In addition to informing the CAB Commander and S3, what actions should you take? (Circle the correct answer.)

[Question 19: NPE 52.4 % correct, PE 60.0 % correct]

A. Continue working the priorities established by the CAB Commander.

B. Change to the priorities requested by the company/ team commanders.

C. Give priority to the thinner skinned M2s.

D. Give priority to the faster firing M1s.

E. Change all remaining positions to hull defilade positions to speed the process.

20. Lane Alice is the route for movement of C Company to the alternate position in the depth of the defense. Given the tactical situation, what technique would best assure that Lane Alice is closed when required? (Circle all that apply.)

[Question 20a: NPE 90.5 % correct, PE 86.7 % correct]
[Question 20b: NPE 81.0 % correct, PE 73.3 % correct]
[Question 20c: NPE 97.6 % correct, PE 83.3 % correct]
[Question 20d: NPE 83.3 % correct, PE 76.7 % correct]

A. Establish a date and time for closure.

B. Transmit a code word from the CAB Main CP to direct closure.

C. Designate the senior engineer in the area as the firing commander and have him execute closure when he determines the enemy is near.

D. Authorize the C Company Commander to execute closure on his initiative or after predetermined criteria.

Appendix E

Descriptives

Table E-1
Commissioning Source

	Prior Enlisted		Non-prior Enlisted	
Value	Frequency	Percent	Frequency	Percent
ROTC	7	22.6	18	43.90
USMA	2	6.5	13	31.70
OCS	20	64.5	10	24.4
Other	2	6.5	1	2.4
Total	31	100	42	100

Table E-2
Undergraduate Major

	Prior Enlisted		Non-prior Enlisted	
Value	Frequency	Percent	Frequency	Percent
Business	8	27.6	8	19.5
Engineering	4	13.8	11	26.8
Humanities	13	44.8	19	46.3
Science	4	13.8	3	7.3
Total	29*	100	41**	100

Note. *2 participants did not respond. ** 1 participant did not respond.

Table E-3

Defensive Planning Prior Knowledge Test Item Statistics

Q. No.	Mean	SD	Q. No.	Mean	SD
1	.63	.49	11b	.64	.48
2	.44	.50	11c	.85	.36
3a	.65	.48	11d	.50	.50
3b	.33	.47	11e	.78	.42
3c	.41	.50	12a	.86	.35
3d	.29	.46	12b	.86	.35
4a	.56	.50	12c	.58	.50
4b	.97	.16	12d	.99	.11
4c	.78	.42	12e	.65	.48
4d	.51	.50	12f	.99	.11
4e	.11	.32	12g	.96	.19
4f	.87	.34	13a	.60	.49
5a	.40	.49	13b	.67	.47
5b	.68	.47	13c	.79	.40
5c	.90	.31	13d	.40	.49
6	.45	.50	14a	.77	.42
7a	.74	.44	14b	.54	.50
7b	.46	.50	14c	.92	.27
7c	.67	.47	14d	.51	.50
7d	.53	.50	15	.67	.47
8a	.58	.50	16	.05	.22
8b	.99	.11	17	.33.	.07
8c	.51	.50	18a	.95	.22
8d	.35	.48	18b	.85	.36
8e	.55	.50	18c	.87	.34
8f	.72	.45	18d	.44	.50
8g	.74	.44	18e	.81	.40
9	.54	.50	18f	.67	.47
10a	.68	.47	19	.54	.50
10b	.86	.35	20a	.88	.32
10c	.40	.49	20b	.78	.42
10d	.62	.49	20c	.92	.27
10e	.81	.40	20d	.81	.40
11a	.67	.47			

Note. N = 78 respondents.
Mean = Percent correct responses.

Table E-4

Defensive Planning Prior Knowledge Test Item Difficulties for Non-prior Enlisted Officers

Question Number	% Correct Responses	Question Number (Cont.)	% Correct Responses (Cont.)	Question Number (Cont.)	% Correct Responses (Cont.)
1	100	20b	81	3c	50
8b	100	12a	78.6	4d	50
12f	100	7a	76.2	8c	50
4b	97.6	3a	73.8	9	50
12d	97.6	4c	73.8	10a	50
14c	97.6	8g	73.8	11d	47.6
20c	97.6	11b	71.4	12c	47.6
12g	95.2	18f	71.4	5a	45.2
18a	95.2	8f	69	7b	45.2
5c	92.9	13b	69	14d	45.2
4f	90.5	5b	66.7	6	42.9
18b	90.5	11a	66.7	18d	42.9
20a	90.5	7c	64.3	3b	40.5
10e	88.1	10d	64.3	8d	38.1
10b	85.7	13a	64.3	10c	38.1
11c	85.7	15	64.3	13d	38.1
13c	85.7	7d	59.5	2	33.3
12b	83.3	12e	59.5	17	31
18c	83.3	4a	57.1	3d	23.8
20d	83.3	8a	57.1	4e	9.5
11e	81	14b	57.1	16	0
14a	81	8e	52.4		
18e	81	19	52.4		

Note. N=42 respondents (Non-prior enlisted officers).